



Installation, Operation and Maintenance Manual

Degassed Cation Conductivity Panel (DCCP)

SPD 1.43.2 Rev. 8 01/09

SENTRY EQUIPMENT CORP

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Additional Resources Attached

- Resin Colum IOM
- Watlow 935 Configuration Work Instruction
- Watlow 935A User’s Manual

WARNING notices as used in this manual apply to hazards or unsafe practices, which could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices which could result in minor personal injury or property damage.

NOTES highlight procedures and contain information which assists the operator in understanding the information contained in this manual.

WARNING

Do not install, maintain, or operate this equipment without reading, understanding and following the proper Sentry Equipment Corp. instructions. Otherwise, injury or damage or both may result.

NOTICE

The information contained in this document is subject to change without notice.

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Normal business hours: 7:00 a.m. to 4:30 p.m. CST (U.S. Central Time), Monday through Friday

SAFETY PRECAUTIONS

Please read the entire manual before attempting to unpack, set up or operate this product. Pay careful attention to all warnings, cautions and notes. Failure to do so could result in serious personal injury or equipment damage.

Use of Hazard Information

If multiple hazards exist, the signal word corresponding to the greatest hazard shall be used.

Definitions



Indicates an imminently hazardous situation, which if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation, which if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation, which if not avoided, may result in minor or moderate injury.



CAUTION used without the safety alert symbol indicates a potentially hazardous situation, which if not avoided, may result in property damage.

NOTE

Information that requires special emphasis

SHALL

This word understood to be mandatory

SHOULD

This word understood to be advisory

⚠ WARNING

It is solely the responsibility of the user, through its own analysis and testing, to select products suitable for their specific application requirements, ensure they are properly installed, ensure that they are safely applied, ensure they are properly maintained, and limit their use to their intended purpose.

Improper selection, installation, or use can cause personal injury or property damage.

Sentry does not warrant against erosion and corrosion. Sentry makes no claims regarding suitability for specific use, and provides no warrantee regarding material compatibility of elastomers in specific services.

⚠ WARNING

Hot Surfaces! This equipment may have very hot surfaces. If an operator contacts a hot surface, injury may occur. Use protective clothing to prevent injury. If other equipment comes in contact with a hot surface, damage to the equipment may occur. Ensure the area around this equipment is kept clear to prevent damage from occurring.

⚠ WARNING

High Pressures! This equipment may contain fluids at very high pressures. Prior to installing, removing or maintaining this equipment, ensure that the equipment is isolated from all connecting piping, the equipment is de-pressurized, the contents have been drained and the equipment is cool.

1.0 General Description



To ensure the protection provided by this equipment is not impaired, this equipment must not be installed or used in any manner other than that which is specified in this manual.

The Sentry Degassed Cation Conductivity Panel is available in various configurations with and without conductivity cells and cation exchange column depending on each customer's individual requirements. Panels without the conductivity cells before the reboiler and without the exchange column are designed to be used in conjunction with an analysis panel which contains these components.

2.0 Installation & Operation



Burn Hazard – Steam exiting the degas chamber can cause burns. Installation should allow for adequate ventilation of steam.



This instrument should be installed by qualified technical personnel to ensure adherence to all applicable codes.

Choose a mounting location. Before installation the final location should be reviewed for the following:

- 1) Floor or wall must have adequate structural capability.
- 2) Anchor location and design is adequate.
- 3) Operation and maintenance space is sufficient.
- 4) Cooling water is available.
- 5) Floor drain is accessible if required.
- 6) Mounting surface is flat/level and at appropriate height.
- 7) There is adequate light for operation and maintenance.

For optimum equipment reliability and installation the area should:

- 1) Be free from mechanical vibration.
- 2) Be free from corrosive media.
- 3) Have a normal ambient temperature near 75-80°F with minimal variation.
- 4) Be free from strong heat radiation.

Provide adequate support and anchoring to minimize gravity and thermal loads on the connections and to minimize any vibration effect.

Connect Sample Lines

The samples enter the DCCP at either the flow indicator (FICV-1) inlet or at the bottom of the boiler tube (depending on model purchased). Both connections are 1/4" tube compression fittings. Clean and deburr all connecting pipe and tubing before installing.

NOTE

Samples supplied to the DCCP should be cooled to (preferably) 25°C (77°F) and pressure controlled by either a backpressure regulator or head cup to maintain a constant sample flow rate.

If you have purchased the DCCP without factory mounted cell holders, refer to Figure 1 for proper cell mounting and drain piping configurations. Cell holders must be installed in an orientation that maintains the water level in the degas chamber near the cross over section of the degas chamber. To accomplish this, the sample outlet from the panel must be even with the cross over section of the degas chamber. It is important to follow these instructions to obtain accurate conductivity measurements.

NOTE

Improper venting of steam from degas chamber or improper cell holder locations may adversely effect the operation of the unit.

Connect Cooling Water

Connect the cooling water inlet piping to the bottom of the cooler (3/8" NPT) and cooling water outlet to the top (3/8" NPT). See Figure 1.

NOTE

Throttling of cooling water flow should be done at the cooler outlet.

Connect Electrical Wiring

Connect plant electrical supply wiring of ample rating as indicated on the Electrical Wiring Diagram, Fig. 2.

Start-up and Operation (refer to General Arrangement Drawing Fig. 1)

Unit will be hot during normal operation.

Initiate sample flow through the reboiler. Adjust sample flow to 100 - 150 cc/min. Turn the heater power switch SW-1, to "ON". Verify that the indicator lamplights and the display on the controller are functioning.

NOTE

The indicator will cycle on and off with the heater.

NOTE

The Degas chamber may show signs of the insulation coating bubbling. This is acceptable and does not affect the insulation performance or functionality.

Allow sample to flow for approximately one day to stabilize.

The controller has been preprogrammed at the factory. If additional trimming of the controller is required, the heat range setting should be between 106°C to 108°C based on sample flow rate. When the heater and flow rate are set properly, a constant column of water vapor should be visually identifiable. If no vapor is seen, the flow rate must either be reduced, or the temperature must be increased until the column of steam is constant. If droplets of hot boiling water are seen venting from the re-boiler the heater is either set too high or the flow rate is too low, and one or the other, or both may have to be adjusted. **Adjustment must always be set in the above specified ranges for flow rate and temperature settings--never go below or above these design parameters.**

⚠ WARNING

Burn Hazard – Boiling water over the top of the degas chamber can cause burns. Maintain appropriate sample flow rates and temperature set points.

System Shutdown

The system is designed to provide simple methods of shutdown. When shutting down the reboiler for service, close the sample inlet valve. If the sample cooler is to be serviced, close the cooling water inlet and outlet isolation valves. When servicing the reboiler or any electrical device, main power must be turned off to eliminate the possibility of personal injury.

3.0 Maintenance

⚠ WARNING

Potential Fire Hazard – Replace fuses only with the same fuse type and ratings.

⚠ WARNING

Electrical Shock Hazard – Disconnect all power before servicing.

⚠ WARNING

Burn Hazard – Isolate sample and allow unit to cool before servicing. Degas chamber could be full of water and burn operator when servicing.

On a routine basis check all connectors, valves, and other components for signs of leakage. Repair as required.

Analyzer Electrodes

A routine schedule should be used for replacement and/or cleaning of analyzer electrodes, refer to manufacturer's literature. Cleaning may alleviate problems, however, we suggest replacing the electrode. Frequent attention may be required to calibrate and maintain a marginal electrode.

4.0 Spare Parts List

Recommended Spare Parts

Tag No.	Qty	Description	p/n
HTR-1	1	Heater, 120V	4-01308T
		Heater, 120V, CSA Version	4-05935A
		Heater, 240V	4-05935B
FU-1	1	Fuse, Controller, 1/2A	4-01235F
FU-2	1	Fuse, Heater 120V, 15A	4-01235E
		Fuse, Heater 240V, 8A	4-01235Z
SC-1	4	Gasket, Cooler	2-00602B
TIC-1	1	Controller, Temperature	4-04555Q

Vendor Literature

SPD 6.2.3	Resin Column Installation and Operating Instructions
16-05040A	Configuration of Watlow 935 Controller (4 pages)
0600-0015-0000	Watlow Temperature Controller User's Manual

5.0 Drawings

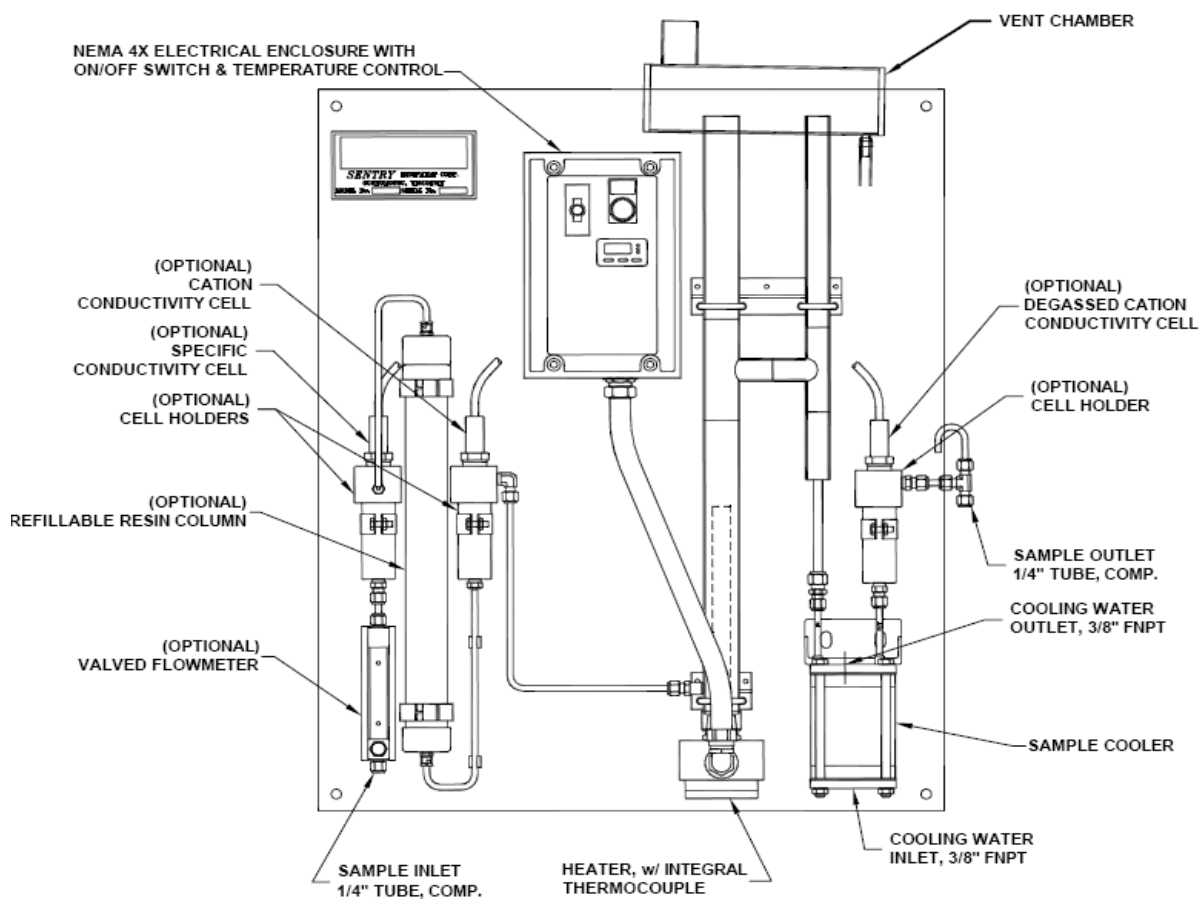


Figure 1 – Degassed Cation Conductivity Panel General Arrangement

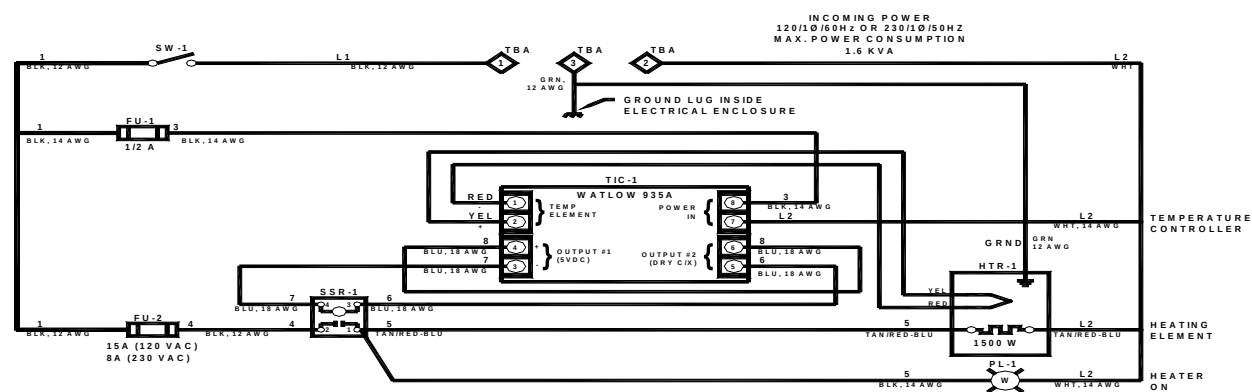


Figure 2 – Electrical Wiring Diagram

6.0 Warranty

Seller warrants products manufactured by it and supplied hereunder to be free from defects in materials and workmanship for a period of twelve months from date of shipment. If within such period any such products shall be proved to Seller's satisfaction to be defective, such products shall be repaired or replaced at Seller's option. Seller's obligation and Buyer's exclusive remedy hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defect within 10 days after its discovery and, at Seller's option, return of such product to Seller, ex-works Sentry's factory.

The foregoing warranties are exclusive and in lieu of all other express and implied warranties except in title, including but not limited to implied warranties of merchantability and fitness for purpose. Seller shall not be subject to any other obligations or liabilities whatsoever with respect to products manufactured or furnished by it, or any undertakings, acts or omissions relating thereto.

Warranty Conditions & Limitations

This Warranty shall not apply to any Sentry product which, in the opinion of Sentry Equipment Corp, has been (a) altered or repaired in a manner affecting the efficiency of performance of the unit or (b) incorrectly installed or operated or (c) damaged in shipment or (d) damaged by flood or fire or (e) if the serial number is missing, altered or defaced.

The owner shall be responsible for maintenance of his equipment. Wear or damage caused by lack of normal maintenance or by misuse of the equipment shall not be considered as defective workmanship and material.

Sentry reserves the right to make product design changes or improvements without notice and without imposing any obligation upon itself to install these changes or improvements on its products previously manufactured.

This warranty is for the sole benefit of the original purchaser and is not transferable unless agreed to in writing by Sentry Equipment Corp.

Receiving Shipments (including loss or damage by transportation)

It is the customer's responsibility to check for missing cartons and sign of damage to cartons. If found, customer should note missing and/or damaged cartons on the delivery receipt and have delivery receipt signed by the representative of the transportation company. If unpacking discloses concealed damage from rough handling, the customer should request a concealed damage inspection from the transportation company.

The Sentry Customer Service Department will aid your organization in any claim proceeding for shortages or damages in shipment, but it is the receiver's responsibility to file claim with the carrier for damage or loss.

Customer Actions For Claims on Products During the Warranty Period

1. Contact the Customer Service Department at Sentry Equipment Corp, Oconomowoc, WI, Telephone: 262-567-7256, to obtain a Return Material Authorization (RMA) number.
2. You will be sent an "RMA" and a "Decontamination Statement" that is required to be filled out and **returned with the equipment.**
3. The following information must appear on the outside of the package:
 - a. RMA number marked on outside of box.
 - b. Decontamination Statement filled out and attached to outside of box.
4. Return defective equipment **FREIGHT PREPAID**. Collect shipments will be refused.
5. The factory will not process warranty claims until the customer has properly accomplished the above items.
6. The Sentry factory may accept the entire claim, a part of the claim, or none of the claim if our inspection of returned parts proves the failure was for reasons other than defective material or factory workmanship.

Important Notes:

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Installation, Operation and Maintenance Manual

RC-100 Resin Column

SPD 6.2.3 Rev. 6 1/08

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1.0 General Description

The Sentry RC-100 Resin Column is a resin filled column that converts positive ions in the solution into hydrogen ions. By measuring the conductivity of the solution immediately before and after it has passed through the Resin Column, comparisons can be made between Specific Conductivity (before Resin Column) and Cation Conductivity (after Resin Column). The RC-100 is made from virgin polycarbonate, Delrin, polyethylene, and nitrile selected to ensure accurate sampling. The column is refillable with pre-measured resin bags (Sentry part # 2-03972A).

2.0 Installation



This equipment must not be installed or used in any manner other than that which is specified in this manual. Read and understand all warnings and instructions before proceeding with installation.

Assembly

This package contains (1) resin column, (2) mounting clamps, (2) pair of quick disconnect fittings, and (1) resin refill bag. Remove the quick disconnect fittings from the plastic bag and install them in the column using a liquid type thread sealant. **Do not use Teflon tape.** The other end of the quick disconnect is designed to be used with 1/8" I.D. tubing.

Locate the (2) quick release mounting brackets as required on 14 1/4" centers.

Filling

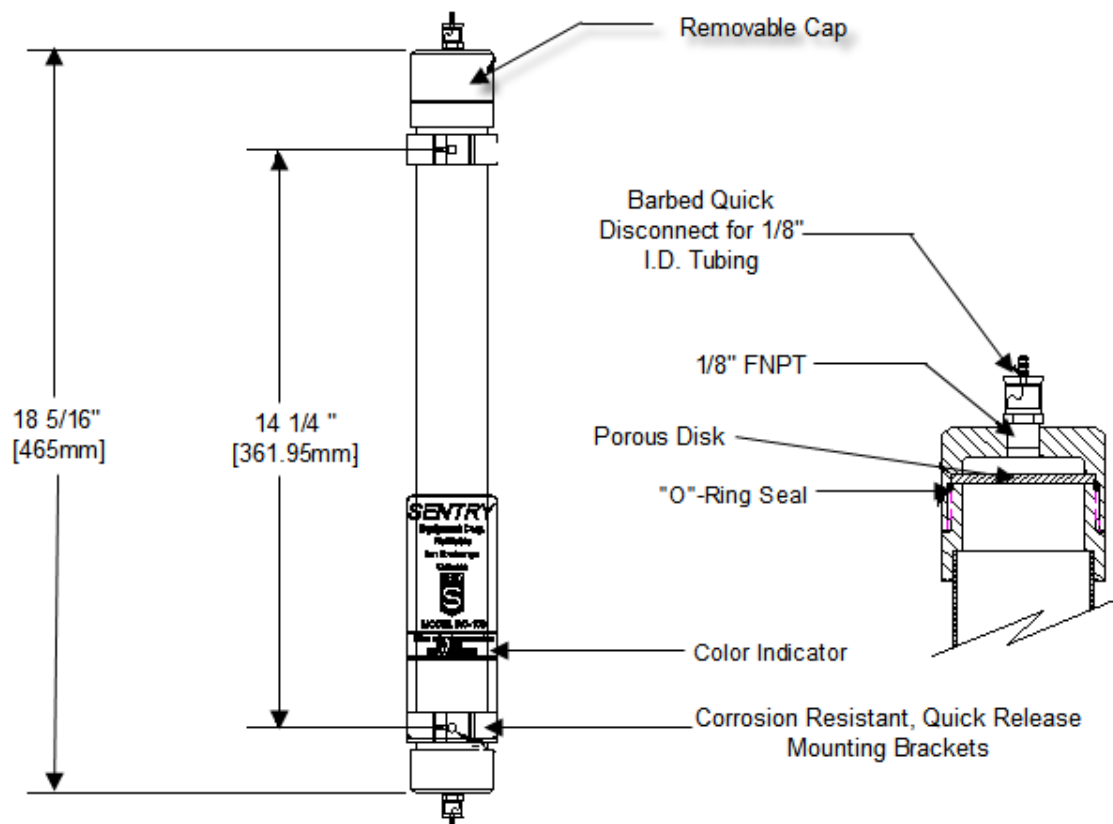
Fill the resin column per the instructions on the resin refill bag (Sentry part # 2-03972A). Sentry recommends replacing the flow distribution disk and "o"-ring at every other refill. These parts can be obtained by Sentry part # 6-02503A.

3.0 Operation

The Resin Column is designed for water flow from top to bottom. Color change of the Resin will progress from the top to the bottom with use. When the color change reaches the color indicator on the label (see **Figure 1**), it is time to change the Resin.

5.0 Maintenance

Figure 1.



Maintenance consist of changing resin, porous disc and "O"-Rings when color change reaches "Color Indicator".

6.0 Spare Parts List

Name	Sentry part #
Kit – (2) Flow Distribution Disks and (2) "O"-Rings	6-02503A
Resin Bag	2-03972A

6.0 Warranty

Seller warrants products manufactured by it and supplied hereunder to be free from defects in materials and workmanship for a period of twelve months from date of shipment. If within such period any such products shall be proved to Seller's satisfaction to be defective, such products shall be repaired or replaced at Seller's option. Seller's obligation and Buyer's exclusive remedy hereunder shall be limited to such repair and replacement and shall be conditioned upon Seller's receiving written notice of any alleged defect within 10 days after its discovery and, at Seller's option, return of such product to Seller, ex-works Sentry's factory.

The foregoing warranties are exclusive and in lieu of all other express and implied warranties except in title, including but not limited to implied warranties of merchantability and fitness for purpose. Seller shall not be subject to any other obligations or liabilities whatsoever with respect to products manufactured or furnished by it, or any undertakings, acts or omissions relating thereto.

Warranty Conditions & Limitations

This Warranty shall not apply to any Sentry product which, in the opinion of Sentry Equipment Corp, has been (a) altered or repaired in a manner affecting the efficiency of performance of the unit or (b) incorrectly installed or operated or (c) damaged in shipment or (d) damaged by flood or fire or (e) if the serial number is missing, altered or defaced.

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SENTRY EQUIPMENT CORP.

WORK INSTRUCTION Document#16-05040A

Operation Description: Configuration of Watlow 935 Controller for Degassed Conductivity Heater Control (DCCP)

Part Description: Watlow 935A-1CD0-000G Controller (SEC P/N 4-04555Q) when used to control the Degassed Conductivity heater

Written By: DJC **Date** 04/12/02 **Rev#** 1

Approvals: (initials & date)

DJC 6/18/02	MSJ 7/1/02	WPA 6/27/02	SER 7/1/02
Engineering	Manufacturing Eng	QA	VP Eng/Operations

IMPORTANT

ALL INSTRUCTIONS BELOW MUST BE COMPLETED PER THE ENGINEERING PRINTS SPECIFIED ON THE SHOP ORDER BILL OF MATERIALS.

MINIMUM OPERATOR QUALIFICATIONS

Assembler "B" or Qualified Customer Personnel

REQUIRED EQUIPMENT

1. N/A

REQUIRED MATERIALS

1. N/A

SAFETY EQUIPMENT

1. Safety Glasses
2. Safety Shoes

OPERATION

Background

Heat control is performed from a type K thermocouple located inside the heater. When flow to the unit is lost, the heater will begin to over-heat. An alarm contact on output 2 prevents the heater from continuing to operate. This alarm can be set up one of two ways:

1. Latching: When the heater begins to over-heat, a latching alarm contact on output 2 of the controller will prevent the heater from operating until the operator restores flow and clears the alarm on the controller by pressing the SET key.

2. Non-latching: This alarm self clears when the heater temperature falls below the alarm set point. When the temperature of the heater cools, the heater will resume operation even if flow to the DCCP is not restored. This configuration may be desired when frequent loss of flow occurs and the DCCP must operate unattended, such as the case of a cycling plant.

Note

The flow through the unit MUST be set to a range of 100 to 200 cc/min to ensure the heater remains submerged. This must be performed prior to applying power to the unit and setting the parameters in the controller to prevent damaging the heater. If cooling water is not supplied to DCCP, remove any cells downstream of heater and plug cell holders.

1. Enter the Operations menu by pressing the UP and DOWN keys simultaneously for 3 seconds.
2. Select the [CnFg] menu by selecting the DOWN key until CnFg appears.
3. While pressing the SET key, choose [yes] with the UP key.
4. Release the SET key to see the first [CnFg] prompt: [In].
5. Set up the following parameters (in order as they appear):

Note

Use the UP and DOWN keys to select a parameter. While pressing the SET key, select a value with the UP and DOWN keys.

<u>Parameter</u>	<u>Value</u>	<u>Description</u>
In	H	Change the input to a type K thermocouple
C_F	C	Unit of Measure (enter °C if desired)
Ot2	ALM	Set output 2 as an alarm output
Alty	Prnc	Alarm type is a Process Normally Closed
*** Lat	yes or no	yes - Latching Alarm (requires pressing SET to clear) no - Non-latching Alarm (self clears)
Ot1	heat	Set output 1 function as "HEAT"
tAg		Clear initial value (PCOA) and leave blank; sets lockout to full access

***** Sentry default is a non-latching alarm.**

6. Return to the Temperature Display by pressing the UP and DOWN keys simultaneously for 3 seconds.
7. Enter the Operations menu by pressing the UP and DOWN keys simultaneously for 3 seconds
8. Select the [Ah1] menu by pressing the UP key. While pressing the SET key, use the UP and DOWN keys to set the high alarm set point to 110°C(230°F).
9. Return to the Temperature Display by pressing the UP and DOWN keys simultaneously for 3 seconds.
10. Enter the Operations menu by pressing the UP and DOWN keys simultaneously for 3 seconds. Select the [Pid] menu by pressing the UP key. While pressing the SET key, use the UP key to select [yes]. Set up the following parameters:

Note

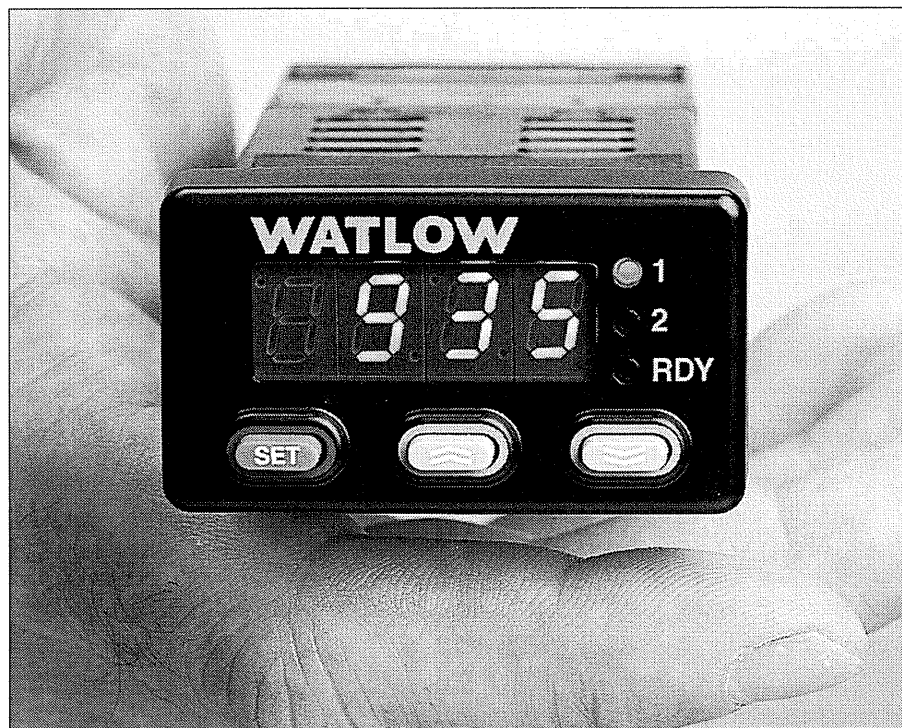
Use the UP and DOWN keys to select a parameter. While pressing the SET key, use the UP and DOWN keys to change the set point.

<u>Parameter</u>	<u>Value/Set Point</u>	<u>Description</u>
Pb h	17	Proportional band-heat
Ct h	2.5	Cycle Time - heat
It	2.75	Integral
De	.10	Derivative

12. Return to the Temperature Display by pressing the UP and DOWN keys simultaneously for 3 seconds.
13. While pressing the SET key, use the UP and DOWN keys to set the target set point to 108°C (226°F).

Series 935A

User's Manual



**Temperature Controller
with Countdown Timer**



U.S. English

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0600-0015-0000 Rev L

January 2002

Supersedes: 0600-0015-0000 Rev K

\$15.00



Safety Alert
CAUTION or
WARNING



Electrical Shock
Hazard

CAUTION or
WARNING

Safety Information in this Manual

Note, caution and warning symbols appear throughout this book to draw your attention to important operational and safety information.

A “NOTE” marks a short message to alert you to an important detail.

A “CAUTION” safety alert appears with information that is important for protecting your equipment and performance.

A “WARNING” safety alert appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.

The  symbol (an exclamation point in a triangle) precedes a general CAUTION or WARNING statement.

The  symbol (a lightning bolt in a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING safety statement.

Technical Assistance

If you encounter a problem with your Watlow controller, review all configuration information to verify that your selections are consistent with your application: inputs; outputs; alarms; limits; etc. If the problem persists after checking the above, you can get technical assistance by calling your local Watlow representative (see back cover of this manual), or in the U.S., dial +1 (507) 454-5300. For technical support, ask for an Applications Engineer.

Please have the following information available when you call:

- Complete model number
- All configuration information
- User’s Manual
- Diagnostic menu readings

Warranty and return information is on the inside back cover of this manual.

Your Comments

Your comments or suggestions on this manual are welcome. Please send them to the Technical Literature Team, Watlow Winona, 1241 Bundy Boulevard, P.O. Box 5580, Winona, Minnesota, 55987-5580 U.S.; Telephone: +1 (507) 454-5300; fax: +1 (507) 452-4507.

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Introduction

Welcome to the Watlow Series 935A!

General Description

The Series 935A is a temperature controller with countdown timer for industrial, commercial, or scientific applications. It offers 1/32 DIN panel-mounting, digital indication, single temperature sensor input from a thermocouple or RTD, and dual control outputs. Outputs may operate in combinations of heat or cool, and alarm or timer.

Special Features

- Easy to use operator interface and user's manual
- Compact panel footprint; 1/32 DIN size
- Water and corrosion proof; IP65/NEMA 4X rated
- Reliable; built to UL, CUL approved safety standards with a three year warranty
- Accuracy with economy
- Universal power supply for worldwide application

Unique Features

The Series 935A Output 1 can be configured as a remote set point input for a multi-loop control system, or, as an alternative, that output can be a front panel lock with your switch to further reinforce the 935A's lockout capability. The Series 935A timer functions include heat/timer or cool/timer countdown modes in hours:minutes or minutes:seconds.

Figure 1 - Series 935A Input and Output Overview

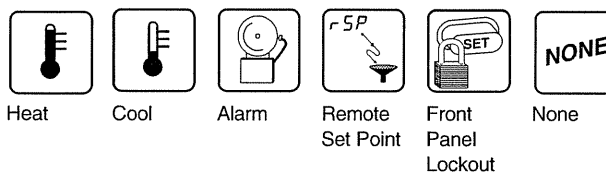


Single Input

Type J, K, T, N, S, E Thermocouple, 1° RTD, or 0.1° RTD

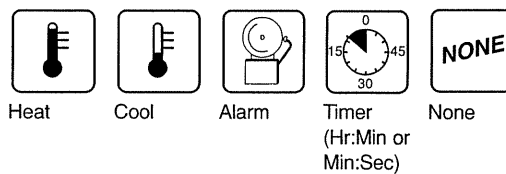
Output 1

Switched dc



Output 2

Electromechanical Relay, Switched dc or Solid-state Relay



- The function of Output 1 determines the options available for Output 2.
- First select the function of Output 1. Refer to the table (right), then select the function of Output 2.

Table 1 - Valid Output Functions

First select Output 1:	Then select Output 2:
Heat	None, Cool, Alarm, Timer
Cool	None, Heat, Alarm, Timer
Alarm	None, Heat, Cool
Remote Set Point	Heat, Cool
Front Panel Lock	Heat, Cool, Alarm
None	Heat, Cool, Alarm



Read or change

You can simply:

- Read the normally displayed actual temperature,

or...

- Press and hold **SET** to read the set point,

or...

1. Press and hold **←** and **→** simultaneously for three seconds to move to a software menu.
2. Press and hold **SET** to display a choice or value.
3. While continuing to press **SET**, press **←** or **→** to choose new data or select a new value.
4. Release **SET** and the arrow key to complete the change.

NOTE: The normally displayed actual temperature and set point can be altered to show different combinations of actual temperature, set point temperature, or time in hours:minutes or minutes:seconds. See **6.5P** p. 16.

Figure 2 - Series 935A Front Panel Functions

Seven-segment alphanumeric display:

- Shows process value, set point information, time, or
- Shows prompt name or value, depending on the key combination pressed.

**Set Key: **

- Configurable to shift between normally-displayed value and set values. See , p.16.
- Clears a latched alarm.

LED 1:

Lit when Output 1 is active.

LED 2:

Lit when Output 2 is active.

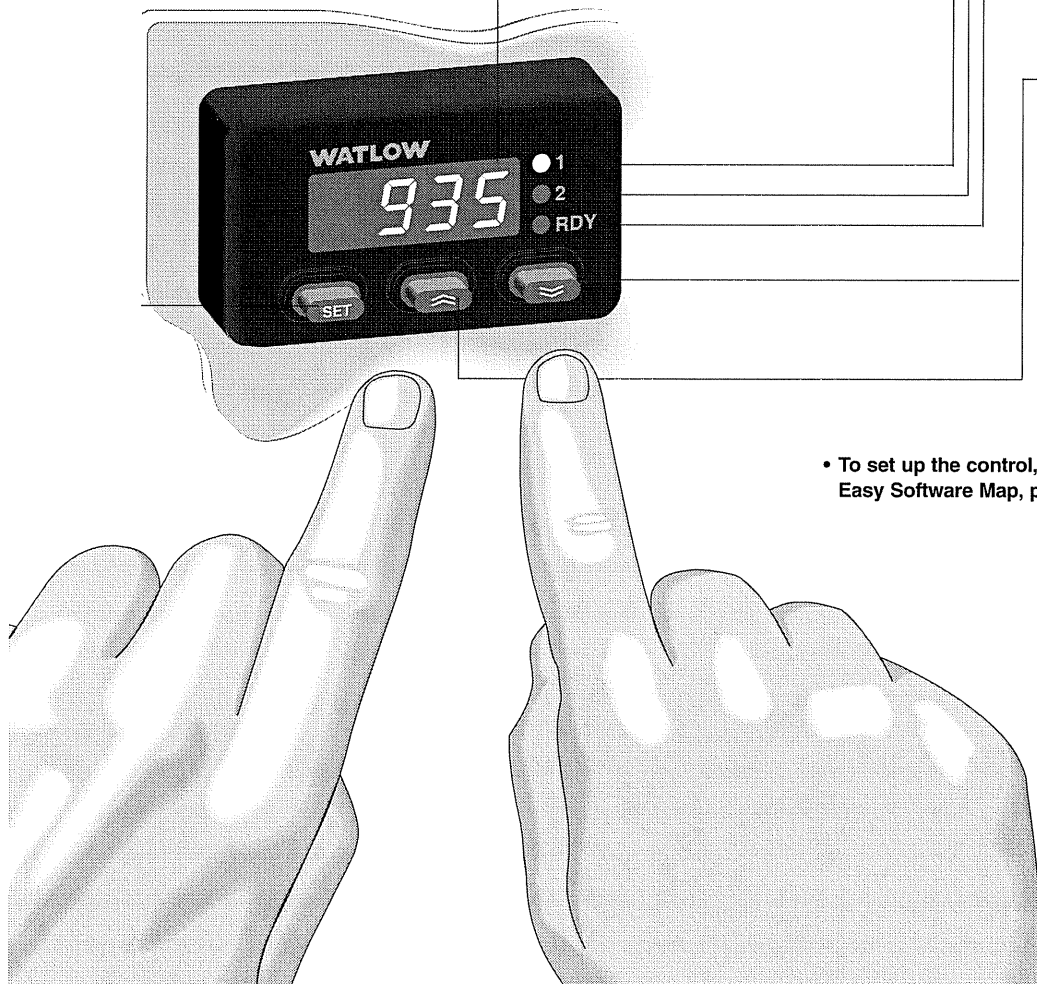
RDY:

Lit when the process temperature is inside the timer ready band.

**Up / (Increment)
Down / (Decrement) Arrow Key:**

- Selects new information when Set Key is pressed.
- Steps through software menus and parameters.
- Starts and stops the timer.

- To set up the control, go to the Easy Software Map, p. 9.

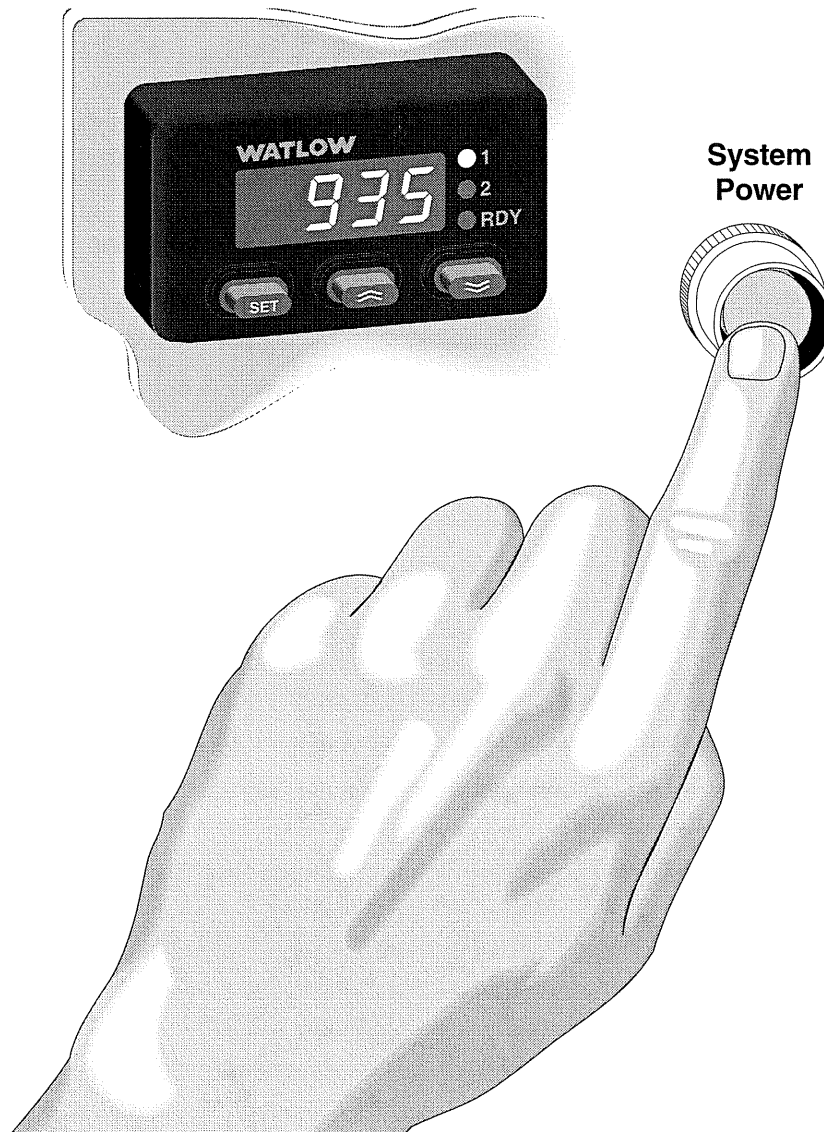




Begin Controlling

1. Apply power to the system.
A properly-wired Series 935A will begin controlling the thermal system as soon as you apply power to it.
 2. Look at the Series 935A's display. It is reading actual temperature, set point temperature, or time.
- To change set point, go to p. 7.
 - The Series 935A will auto-tune when you tell it to, go to p. 32.
 - If you see an error, go to p. 8.

Figure 3 - Begin Controlling





Change Set Point

Your Series 935A displays the actual process temperature when it comes from the factory. You can change it to normally display the set point or time. Go to p. 16, see **DISP.**

1. Press and hold **SET**.
2. Press one of the arrow keys to alter the set point either upward or downward.
3. Release **SET** to complete the change.

Figure 4 - Changing the Set Point



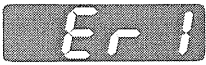


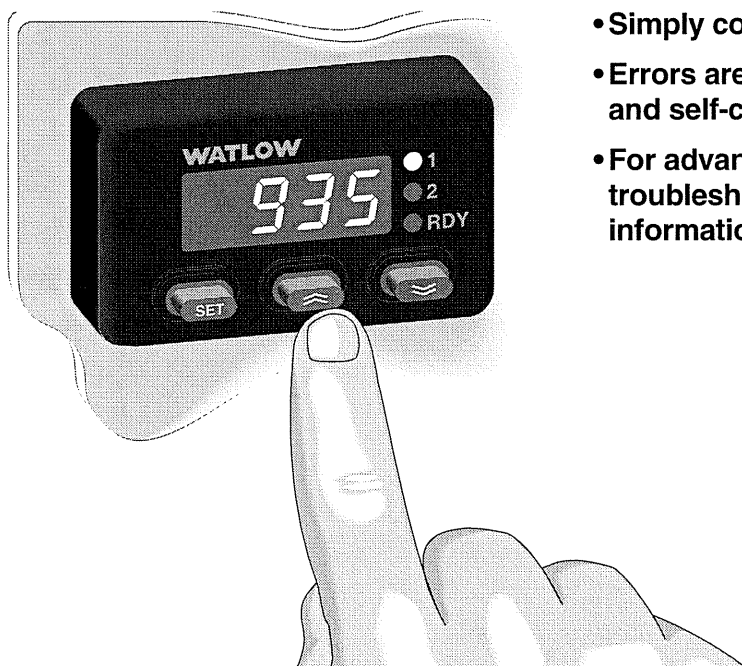
Respond to a simple error

If You See An Error Code:

1. Be aware that most errors are input (sensor) related.
2. Read the table below and follow its recommendations.

Table 2 - Error messages and recommended action

Display	Probable Cause	Recommended Action
	Reversed thermocouple connection + to -.	Change the sensor leads on Terminals 1 and 2.
	Sensor type mismatch or open RTD.	Go to  prompt, check selection (see p. 20), or check RTD, replace as necessary.
	Sensor type mismatch.	Go to  prompt, check selection (see p. 20).
	Open Thermocouple, bad connection, or broken wire.	Check the sensor, replace as necessary.
	Electrical noise.	Cycle power to system. See if error clears. Check system for electrical interference.
	Control is inoperable.	Check for line voltage at terminals 7 and 8.



- Simply correct the cause.
- Errors are non-latching and self-clearing.
- For advanced error and troubleshooting information, go to p. 37.

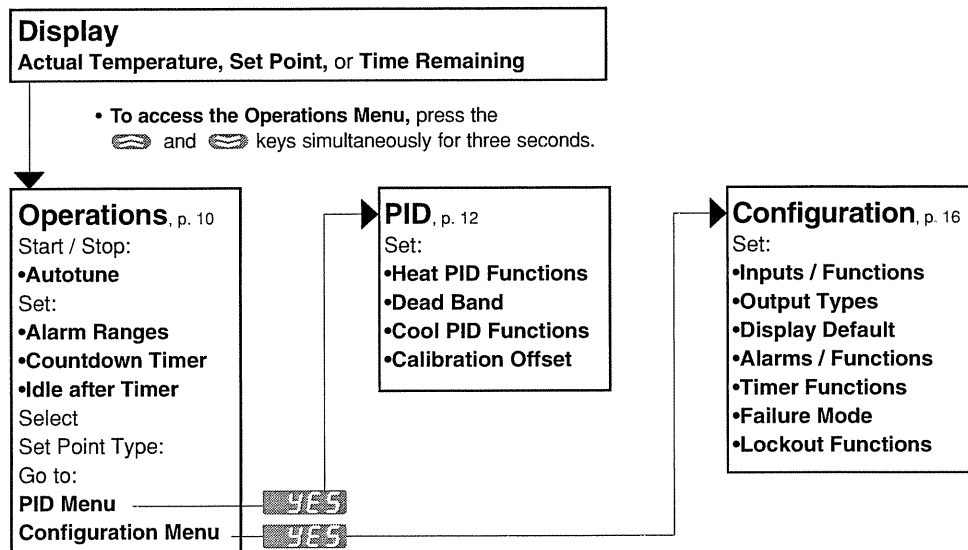


Learn the Software Map

Software Organization

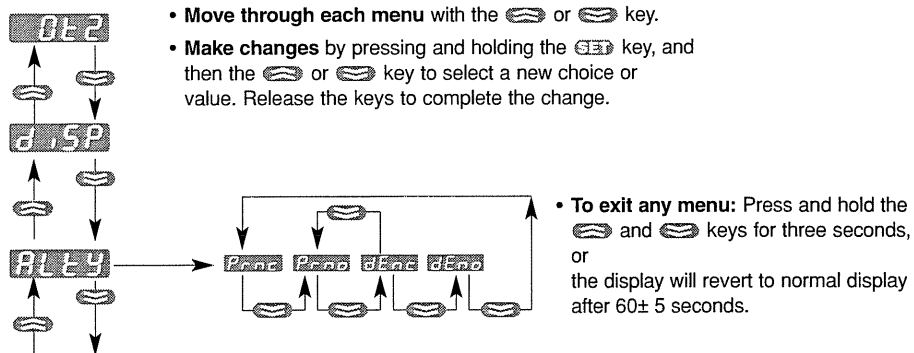
- The Series 935A has three primary menus in addition to a normal display.
- The software reverts to the normal display after 60 ± 5 sec.

Table 3 - Software Organization



- At the **PID** or **CONF** prompt, press and hold the **SET** key, and the **F3** or **F4** key to select **YES**. Release the keys to move to the new menu.

Navigation Example





Learn the Operations Menu

The Series 935A Operations Menu is the first menu you encounter when you press the  and  keys simultaneously for three seconds. The Operations Menu provides a location to initiate the following actions or complete the following tasks:

- **Auto-tune** : Start or stop the auto-tuning process. Auto-tuning selects a set of viable proportional, integral, and derivative values for heat and/or cool output.
- **Alarm Points**,  and : Select the values for the high alarm point and the low alarm point. Alarm points, dependent on sensor type high and low ranges, reside in the Operations Menu for easy access.
- **Timer Countdown Time** : Select a countdown time value between 00:00 and 99:59 hours:minutes or minutes:seconds. Time interval choices  and  reside in the Configuration Menu for Output 2.
- **Idle Set Point** :  or an adjustable value between  and . Choose to have the Idle Set Point track , or equal, the Primary Set Point; or select an Idle Set Point value in °F or °C between the range low  and range high  values. The Idle Set Point is active both before and after the timing sequence. The normal or Primary Set Point controls during the timing sequence.
- **Local/Remote Set Point** ,  or : Choose to maintain control with the Primary  (local) Set Point, or to enable the Remote  Set Point if the Output 1  choice equals Remote Set Point .
- **Go to the PID Menu** : Choose  to proceed to the PID Menu.
- **Go to the Configuration Menu** : Choose  to proceed to the Configuration Menu.

The table on the next page presents this information in graphic form.

NOTE: Not every prompt listed here or on p. 11 in the Operations Menu will appear in your unit. Prompts vary with lockout function and output set-up. Whether or not prompts appear in the Operations Menu depends on two features of the Series 935A:

- Lockout function; the Lockout Tag  function masks prompts from view in the various menus. (If you cannot see a prompt, you can make no change.) See Using Lockout Functions, p. 18, for more information.
- Output 1 and 2 Configuration; some outputs are mutually exclusive. For example, if Output 1 is Alarm, then Output 2 cannot be Timer. Therefore, the Operations menu will have no timer-related prompts. See the Valid Output Functions Table, p. 3, or Setting Up Inputs and Outputs, p. 20.

Table 4 - Operations Menu Overview

To enter the Operations Menu, press the  and  keys simultaneously for three seconds.

Auto-tune

Start the auto-tune action to automatically select a set of viable PID values; **tune** will flash during auto-tuning.

Aut

no

yes

NO

YES

Alarm Low

Select a low alarm point, adjustable between Off, Range Low and Alarm High.

AL0

Rh1

Alarm High

Alarm High

Select a high alarm point, adjustable between Alarm Low and Range High, or OFF.

Rh1

AL0

Alarm Low

Countdown Timer

Select a countdown time duration.

ET77

0000

9959

00:00 to 99:59 Hrs:Min or Min:Sec

Idle Set Point Type

Choose to track set point, or select a separate idle set point adjustable between Range Low and Range High. When **SET** = **LHP** or **RHS**, view the idle set point from the set point display with a three second **SET** press.

IDLE

LHP

RL

RH

Track Set Point

Range Low

Range High

Local / Remote Set Point

Choose to use the remote set point input.

L-R

L

R

Local

Remote

PID Menu

Go to the PID Menu.

Pid

no

yes

NO

YES

Configuration Menu

Go to the Configuration Menu.

CFG

no

yes

NO

YES



Learn the PID Menu

Choose the PID Strategy

You may rely solely on the Auto-tune **Auto** function (p. 32) and factory defaults to determine PID values for your system, or you may use auto-tuning and additional manual adjustments. You must select dead band **db** and calibration offset **Cal** values manually.

The Series 935A PID Menu is the first sub-menu you encounter after moving to the Operations Menu. The PID Menu provides a software location to select the individual heat or cool proportional band, hysteresis, and cycle time values; and the dead band, integral, derivative, and calibration offset values.

To go to the PID Menu:

1. Go first to the Operations Menu by pressing **⏏** and **⏏** simultaneously for three seconds.
2. Scroll through the Operations Menu with **⏏** until you see the **Pid** prompt.
3. While pressing **SE** to display **no**, choose **YES** with **⏏** or **⏏**.
4. Release **SE** to see the first PID prompt.

NOTE: Access to the PID Menu and the prompts there varies with lockout function and output set-up. The PID Menu is locked out when the 935A leaves the factory.

- Lockout function; the Lockout Tag **ERR** function masks menus from view (if you cannot see a prompt, you can make no change). See Using Lockout Functions, p. 18.
- Output set-up; you must choose **HERE** or **COOL** in either Output 1 or Output 2 to have access to the PID Menu. With a **HERE** only choice, **COOL** prompts are not visible, and vice versa. See the Valid Output Functions Table, p. 3, or Setting Up Inputs and Outputs, p. 20.

NOTE: Proportional Band, Integral, Derivative, Dead Band, and Calibration Offset values are adjustable in whole or tenth °F or °C, depending on input type **In and **C.F** Celsius/Fahrenheit Configuration Menu choices.**

Set the PID Menu Values

- **Proportional Band, Heat and Cool** **Pb_h** and **Pb_c**: Select a value (degrees) to set up band on either side ($\pm$) of the Primary Set Point in which the heat and/or cool proportioning function(s) will be active.
For on/off control, set **Pb_h** or **Pb_c** = 0.
Range: 0 to 999°F/555°C, or 0.0 to 999.0°F/555.0°C
Default: 25°F/17°C, or 25.0°F/17.0°C
- **Hysteresis, Heat and Cool** **hys_h** and **hys_c**: For use with on/off control only. Select the value (degrees) for the process variable change required to re-energize the control heat and/or cool output.
For ON/off control, set **Pb_h** or **Pb_c** = 0.
Range: 1 to 999°F/555°C, or 0.1 to 999.0°F/555.0°C
Default: 3°F/2°C, or 3.0°F/2.0°C
- **Cycle Time**, **ct_h** and **ct_c**: Select the value (seconds) required for the heat and/or cool output(s) to complete a full ON through off cycle.
Range: Switched dc/Solid State Relay: 0.1 to 60.0 seconds
Default: 5.0 seconds
Range: Electromechanical Relay: 5.0 to 60.0 seconds
Default: 30.0 seconds
- **Dead Band** **db**: Dead Band adjusts the effective cool set point above the primary set point by the Dead Band value in degrees. This creates a band between the heating and cooling proportional bands where only integral and derivative activity will occur. For more information on Dead Band fine tuning, go to p. 33.
Range: 0 to 999°F/555°C, or 0.0 to 999.0°F/555.0°C
Default: 0°
- **Integral** **ti**: Select a value (minutes/repeat) for the integral function. Integral is the inverse of Reset; $ti(\text{value}) = 1/\text{Reset}(\text{value})$.
Range: 0.00 to 99.99 minutes/repeat
Default: 5.00 minutes/repeat
- **Derivative** **de**: Select a value (minutes) for the derivative function.
Range: 0.00 to 9.99 minutes
Default: 0.00 minutes
- **Calibration Offset** **cal**: Eliminates the difference between the displayed process temperature and the actual process temperature value.
Range: -999 to 9999°F/C, or -99.9 to 999.9°F/C
Default: 0°



Learn the PID Menu - Details

Table 5 - PID Menu Overview

Set-Up Heat

Proportional Band Heat - Select a heat proportional band value.

Pb h	0 999	0 555	0.0 999.0	0.0 555.0
	0°F to 999°F, or	0°C to 555°C, or	0.0°F to 999.0°F, or	0.0°C to 555.0°C

Hysteresis Heat - Select a heat ON/off control switching hysteresis.

hyst h	1 999	1 555	0.1 999.0	0.1 555.0
	1°F to 999°F, or	1°C to 555°C, or	0.1°F to 999.0°F, or	0.1°C to 555.0°C

Cycle Time Heat - Select a cycle time for the heat output.

Ct h	0.1 60.0	5.0 60.0
	0.1 to 60.0 seconds (SSR or Switched dc)	5.0 to 60.0 seconds (Electromechanical Relay)

Dead Band - Select a dead band value.

db	0 999	0 555	0.0 999.0	0.0 555.0
	0°F to 999°F, or	0°C to 555°C, or	0.0°F to 999.0°F, or	0.0°C to 555.0°C

Set-Up Cool

Proportional Band Cool - Select a cool proportional band value.

Pb c	0 999	0 555	0.0 999.0	0.0 555.0
	0°F to 999°F, or	0°C to 555°C, or	0.0°F to 999.0°F, or	0.0°C to 555.0°C

Hysteresis Cool - Select a cool ON/off control switching hysteresis.

hyst c	1 999	1 555	0.1 999.0	0.1 555.0
	1°F to 999°F, or	1°C to 555°C, or	0.1°F to 999.0°F, or	0.1°C to 555.0°C

Cycle Time Cool - Select a cool output cycle time.

Ct c	0.1 60.0	5.0 60.0
	0.1 to 60.0 seconds (SSR or Switched dc)	5.0 to 60.0 seconds (Electromechanical Relay)

Set-Up General

Integral Function - Select an integral value.

0.00 to 99.99 minutes/repeat

Derivative Function - Select a derivative value.

0.00 to 9.99 minutes

Calibration Offset - Select a calibration offset value.

-999° to 9999°F or C or -99.9° to 999.9°F or C

Note: Access to the PID Menu and the prompts there varies with lockout function and output set-up. The PID Menu is locked out when the 935A leaves the factory.

- Lockout function; the Lockout Tag function masks menus from view (if you cannot see a prompt, you can make no change). See Using Lockout Functions, p. 18.
- Output set-up; you must choose or in either Output 1 or Output 2 to have access to the PID Menu. With a only choice, prompts are not visible, and vice versa. See the Valid Output Functions Table, p. 3, or Setting Up Inputs and Outputs, p. 20.



Learn the Configuration Menu

The Configuration Menu is the second sub-menu in the Operations Menu. Use it to set Inputs, Ranges, Output Types, Alarms, Timer, Failure Mode, and Lockouts.

To go to the Configuration Menu:

1. Go first to the Operations Menu by pressing and simultaneously for three seconds.
2. Scroll through the Operations Menu with until you see the **CONF** prompt.
3. While holding to display **no**, choose **YES** with or .
4. Release to see the first **CONF** prompt, **In**.
5. To leave the Configuration Menu, press and for 3 seconds.

Table 6 - Configuration Menu Overview

Input Type - Choose sensor type. See p. 21 for sensor ranges.								
J t/c	K t/c	T t/c	N t/c	E t/c	S t/c	1.0° RTD	0.1° RTD	
Celsius/Fahrenheit - Choose displayed unit of measure.								
°F	°C							
Input Range Low - Select lowest displayable set point. Ranges, p. 21.								
Select a value (lowest displayable set point) between Input Type Range Low and Input Range High.								
Input Range High - Select highest displayable set point. Ranges, p. 21.								
Select a value (highest displayable set point) between Input Type Range High and Input Range Low.								
Output 1 Function - Choose Output 1 type; see Valid Outputs Table, p. 21.								
Heat	Cool	Alarm	Remote Set Point	Front Panel Lock	None			
Output 2 Function - Choose Output 2 type (dependent on Output 1 choice).								
Heat	Cool	Alarm	Timer Hr./Min.	Timer Min./Sec	None			
Display Default - Choose the primary (last 2 characters) and secondary (first 2 characters) default displays. Press to toggle to the secondary display for 15 seconds.								
No secondary Actual temp.	Actual temp. Set point temp.	Actual temp. Time remaining	Time remaining Actual temp.	Time remaining Set point temperature				
Alarm Type - Choose alarm type with output action.								
Process normally closed	Process normally open	Deviation normally closed	Deviation normally open					

NOTE: Access to Configuration Menu varies with lockout function. See p. 19.

Alarm Hysteresis - Choose alarm switching band.

Ahys
 1°F to 999°F, or 1°C to 555°C, or 0.1°F to 999.0°F, or 0.1°C to 555.0°C

Alarm Latch - Choose latching or non-latching alarms.

A latching alarm requires a **SET** press to clear it after the alarm condition clears.

LAt
 NO YES

Alarm Silencing - Choose to silence alarms on startup, or not.

SIL = silence an alarm with a **SET** press.

SIL
 NO YES

Failure Mode - Choose output action after a sensor failure.

Bumpless transfer provides a smooth transition to percent power control without output state change.

FAIL
 Bumpless Percent Power

Timer Output Function - Choose output function for the end of the timer.

Delay ON = Turn ON, Delay Off = Turn off, Signal ON = Toggle ON, Signal off = Toggle off

t1P7
 Delay on Delay Off Signal On Signal Off

Start Timer Function - Choose the start timer conditions:

IP7 = Immediate start on a **SET** press; **rdy** = **SET** press and Actual temp. is inside the Ready Band;

rdyA = **SET** press, plus Actual temp. is inside the Ready Band, then acknowledge with a **SET** press;

Plwr = immediate start on power-up without waiting for the Ready Band temp. or a **SET** press.

StPt
 Immediate Ready Ready Acknowledge Power

Timer Ready Band - If **StPt** = **rdy** or **rdyA**, select ready band high/low values.

rdy
 0°F to 999°F, or 0°C to 555°C, or 0.0°F to 999.0°F, or 0.0°C to 555.0°C

Signal Time - If **t1P7** = **Sgon** or **Sgof**, select a Signal ON or Signal off time duration to trigger an annunciator or other action at completion of countdown time.

St
 1 sec. to 99:59 min:sec.

Set Point Lock - Choose to lock the Primary Set Point from change, not view.

SLoc
 NO YES

Lockout Tag - Choose undisplayable/unchangeable menus; **PL7** = all locked.

LAG



Using Lockout Functions

Configuration Menu

	Input Type
	Celsius/Fahrenheit
	Input Range Low
	Input Range High
	Output 1 Function
	Output 2 Function
	Display Default
	Alarm Type
	Alarm Hysteresis
	Alarm Latch
	Alarm Silencing
	Failure Mode
	Timer Function
	Start Timer
	Timer Ready Band
	Signal Time
	Set Point Lockout
	Lockout Tag

The Series 935A offers three different security, or “lockout,” options. Set up one or all three lockout options in the Configuration Menu.



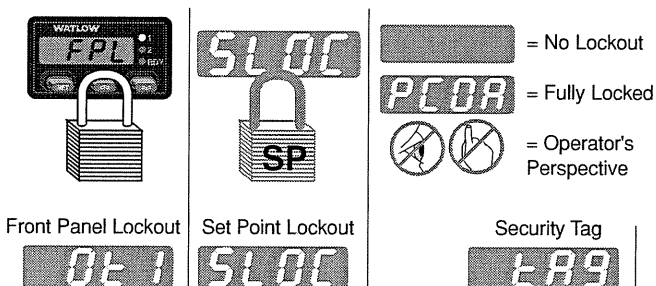
- **Front Panel Lock** **FPL** uses a control output as an input for an external hardware switch; it requires wiring, see p. 23. Choose Front Panel Lock **FPL** as an exclusive Output 1 choice. Output 2 offers heat, cool, or alarm.
- **Choose Set Point Lock** **SLOC** as the simplest lockout option. It locks the Primary Set Point from change, but not from view.
- **Choose the Security Tag** **TAG** as a means of masking the Series 935A software menus from view. By selecting all or part of the four-digit binary acronym, **PCOA** (Proportional / Configuration / Operation / Auto-tune), you can choose to mask those items from view, and therefore from change. For example: In the Configuration Menu **TAG** set-up, if you can see the P, the operator cannot see the PID menu.
- Exceptions to **PCOA** **TAG** are:
 - “C” does not lock out **TAG**.
 - “O” does not lock out **COFAG**.



WARNING: When Output 1 is a Front Panel Lock **OUT1** = **FPL**, the output is energized! Do not connect a power switching device to Output 1; injury or death or damage to equipment or property could result.

Table 7 - Series 935A Lockout Options

Three Lockout Options



							
View Process	Yes	Yes	Yes	Yes	Yes	Yes	Yes
View Set Point	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Change Set Point	No	Yes	No	Yes	Yes	Yes	Yes
Auto-tune	No	Yes	Yes	Yes	Yes	Yes	No
View, Change Operation Menu	No	Yes	Yes	Yes	Yes	No	Yes
View, Change Configuration Menu (except tag)	No	Yes	Yes	Yes	No	Yes	Yes
View, Change PID	No	Yes	Yes	No	Yes	Yes	Yes

Note: Front Panel Lockout requires an external hardware switch. For  set-up and wiring information, see p. 23. For more wiring information, see p. 43.

P = PID Menu
 C = Configuration Menu (except )
 O = Operations Menu (except )
 A = Auto-tune



Setting Inputs and Outputs

Configuration Menu

IN	✓
Input Type	
C F	✓
Celsius/Fahrenheit	
rL	✓
Input Range Low	
rH	✓
Input Range High	
OE1	✓
Output 1 Function	
OE2	✓
Output 2 Function	
dISP	✓
Display Default	
ALB	
Alarm Type	
RAH	
Alarm Hysteresis	
LRE	
Alarm Latch	
SIL	
Alarm Silencing	
FPI	
Failure Mode	
ETD	
Timer Function	
SETE	
Start Timer	
RDY	
Timer Ready Band	
SE	
Signal Time	
SLD	
Set Point Lockout	
LAG	
Lockout Tag	

Key Input/Output Set-up Information

- All initial input and output set-up occurs in the Configuration Menu.
- The 935A requires a thermocouple or RTD input connection to the S1 and S2 Terminals, including when using the remote set point **rSP** option.
- Remote Set Point **rSP** is a second input, wired to OT1 Terminals 3 and 4.
- Indication of °C or °F units of measure occurs only in the **C F** prompt.
- Sensor input type minimum and maximum range (see p. 51) is further defined with Range Low **rL** and Range High **rH** to set the working span of set points and remote set point scaling.
- Output 1 and Output 2 configure the prime functions of the Series 935A, they are the “golden” prompts.
- Output 1 must be heat or cool to use Output 2 as a timer.
- Remote Set Point **rSP** enables Output 1 to act as an input for 0-5= (dc) from another controller or a transmitter.
- Front Panel Lock **FPL** requires an external switch and 62Ω 0.5 watt resistor wired in parallel on Output 1. Switch open = unlocked; closed = locked. See p. 23.
- Output 2 sets timer interval in hours:minutes **ETD** or minutes:seconds **ETD**.
- Display Default **dISP** lets you choose the primary (last 2 characters) and secondary (first 2 characters) default displays. Press **SET** to toggle to the secondary display for 15 seconds.
 - AC** = Normal Display: Actual Temperature
Secondary: None
 - SP** = Normal Display: Set Point Temperature
Secondary: Actual Temperature
 - RE** = Normal Display: Time Remaining
Secondary: Actual Temperature
 - RC** = Normal Display: Actual Temperature
Secondary: Time Remaining
 - RP** = Normal Display: Set Point Temperature
Secondary: Time Remaining

Note: Access to Configuration Menu varies with lockout function. See p. 19.

Table 8 - Setting Inputs and Outputs

Input Type - Choose sensor type.

        
J t/c K t/c T t/c N t/c E t/c S t/c 1.0° RTD 0.1° RTD

Input Range Information

J t/c:	32	to	1382°F	or	0	to	750°C
K t/c:	-328	to	2282°F	or	-200	to	1250°C
T t/c:	-328	to	662°F	or	-200	to	350°C
N t/c:	32	to	2282°F	or	0	to	1250°C
S t/c:	32	to	2642°F	or	0	to	1450°C
E t/c:	-328	to	1470°F	or	-200	to	799°C
1° RTD (DIN):	-328	to	1292°F	or	-200	to	700°C
0.1° RTD:	-99.9	to	999.9°F	or	-99.9	to	700.0°C

Celsius/Fahrenheit - Choose displayed unit of measure.

 
°F °C

Input Range Low - Select lowest displayable Set Point, dependent on .

   Select a value (lowest displayable set point) between Input Type Range Low and Input Range High.

Input Range High - Select highest displayable Set Point, dependent on .

   Select a value (highest displayable set point) between Input Type Range High and Input Range Low.

Output 1 Function - Choose Output 1 type.

     
Heat Cool Alarm Remote Set Point Front Panel Lock None

- The function of Output 1 determines the options available for Output 2.
- First select the function of Output 1. Refer to the table (right), then select the function of Output 2.

Valid Output Functions

First select Output 1:	Then select Output 2:
Heat	None, Cool, Alarm, Timer
Cool	None, Heat, Alarm, Timer
Alarm	None, Heat, Cool
Remote Set Point	Heat, Cool
Front Panel Lock	Heat, Cool, Alarm
None	Heat, Cool, Alarm

Output 2 Function - Choose Output 2 type (dependent on Output 1 choice).

     
Heat Cool Alarm Timer Hr./Min. Timer Min./Sec None

Display Default - Choose the primary (last 2 characters) and secondary (first 2 characters) default displays. Press  to toggle to the secondary display for 15 seconds.

      
No secondary Actual temperature Actual temperature Time remaining Time remaining
Actual temperature Set point temperature Set point temperature



Set Up Remote Set Point Input

Configuration Menu

IN	
Input Type	
C-F	
Celsius/Fahrenheit	
rL	✓
Input Range Low	
rH	✓
Input Range High	
0t1	✓
Output 1 Function	
0t2	
Output 2 Function	
BISP	
Display Default	
FAIL	
Failure Mode	
SLOC	
Set Point Lockout	
LRG	
Lockout Tag	
Operations Menu	
Auto-tune	
L-r	✓
Local / Remote	
PID	
PID	
CONF	
Configuration	

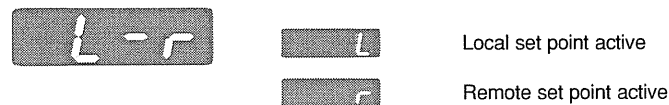
To Set Up Remote Set Point...

1. Wire the control per the example below and the information on p. 42-45.
2. Go to **CONF**, make **IN** and **C-F** choices, then
3. Make **IN** and **C-F** choices, then
4. Scale the 0-5V $\Rightarrow$ (dc) input with **rL** and **rH**.
5. Go to **0t1**, and choose **rSP**.
6. Go to the Operations Menu; **L-r**, choose **r**.

Output 1



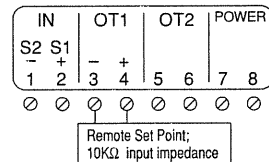
Local / Remote



- Remote Set Point is scaled by **rH** and **rL**.
- 0V input results in a set point of **rL**.
- 5V input results in a set point of **rH**.
- Adjust **rL** and **rH** to match your input to desired set point adjustment.
- The Remote Set Point will display instead of Primary Set Point.
- Auto-tune always uses the Primary Set Point.
- Deviation Alarm uses the active Set Point.

Figure 5 - Remote Set Point Wiring

See p. 42-45 for more wiring information.



NOTE: Sensor required on Terminals 1 and 2.



WARNING: All wiring and fusing must conform to local and national electric codes. Contact local authorities for further information. Failure to comply with electric codes could result in injury or death, or damage to property.



Set Up Front Panel Lockout

Configuration Menu

IN
Input Type
C/F
Celsius/Fahrenheit
rL
Input Range Low
rH
Input Range High
OE 1 ✓
Output 1 Function
OE 2
Output 2 Function
DISP
Display Default
•
•
FRIL
Failure Mode
ETPT
Timer Function
STRT
Start Timer
RDY
Timer Ready Band
SE
Signal Time
SLOP
Set Point Lockout
EPG
Lockout Tag

To Set Up Front Panel Lock...

1. Install an external switch.
2. Wire the control per the example below and the information on p. 42-45.
3. Go to **CFG**, then **OE 1**, and choose **FPL**.

Table 9 - Using Front Panel Lock

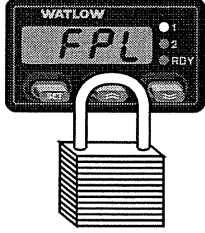
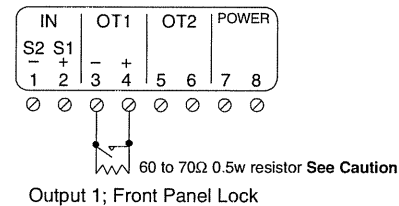
	OE 1 = FPL	
	View Process	Yes
	View Set Point	Yes
	Change Set Point	No
	Auto-tune	No
	Reset Alarm	Yes
	View or Change Operation Menu (Except Config. Menu)	No
	View or Change Configuration Menu (Except Tag)	No
	View or Change PID Menu	No

Figure 6 - Front Panel Lock Wiring

See p. 43 for more wiring information.

(Closed switch = locked)



WARNING: When Output 1 is a Front Panel Lock **OE 1 = FPL**, the output is energized! Do not connect a power switching device to Output 1; injury or death, or damage to equipment or property could result.



CAUTION: Failure to install a 60 to 70Ω, 0.5 watt resistor across the customer-supplied Front Panel Lock switch will cause the panel to lock out even when the switch is open. Injury to personnel, or damage to equipment or property could result.



Learning Alarms

Configuration Menu

In

Input Type

C/F

Celsius/Fahrenheit

rl

Input Range Low

rh

Input Range High

OLE1

Output 1 Function

OLE2

Output 2 Function

DISP

Display Default

ALTS ✓

Alarm Type

ALYS ✓

Alarm Hysteresis

LAL ✓

Alarm Latch

SIL ✓

Alarm Silencing

FAIL

Failure Mode

Operations Menu

ALT

Auto-tune

ALO ✓

Alarm Range Low

Ah1 ✓

Alarm Range High

PID

PID

CFG

Configuration

Alarms signal an excursion from normal operating conditions. In general, audible alarms or lights connected to alarm outputs will signal a problem. In the 935A the front panel LED “1” or “2” indicates an alarm with **h1** or **LO** flashing on the main display.

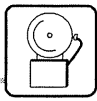
- **Process alarms** use absolute high and low values to trigger an alarm. Use this alarm type if your process may be subject to temperatures that it must not exceed. Use **Ah1** and **ALO** to set alarm points at or near these values. See Table 10: **ALTS**, next page.
- **Deviation alarms** are triggered by a deviation from the set point. The alarm high value **Ah1** is the deviation above set point, and the low value **ALO** is the deviation below set point. Whenever the set point is adjusted, the alarm settings are relative to that value. Deviation alarms use the currently controlling set point, whether primary, remote, idle, or 90% of primary, during auto-tuning. See Table 10: **ALTS**, next page.
- **Normally Open, ~~deNo~~ or ~~Prnc~~, Alarms** energize the alarm output when an alarm condition occurs, and de-energize it when cleared. Use this type to activate external devices such as audible alarms or lights. See Table 10: **ALTS**, next page.
- **Normally Closed, ~~deNo~~ or ~~Prnc~~, Alarms** de-energize the alarm output when an alarm condition occurs, and energize it when the alarm is cleared. Use this type as a “deadman” switch where system continuity is required for operation. See Table 10: **ALTS**, next page.

For example, by running the control output through the alarm output, you can set a normally closed process alarm to disable the process when the process exceeds the alarm set point. The alarm output will be off when power is off.
- **Alarm Hysteresis** sets a point the process must pass on a return (from an alarm condition excursion) to the **ALO** and **Ah1** points before the alarm can clear. This prevents the alarm output from “chattering” if the process is hovering around the alarm set point. See Table 10: **ALYS**, next page.
- **Latching Alarms** require the operator to clear them with a **β** press after the process returns to a safe, or non-alarm condition. Non-latching alarms self-clear. See Table 11: **LAL**, p. 27.
- **Silenced Alarms** provide a means to clear the alarm output with a **SET** press even if the alarm condition still exists. The flashing **h1** or **LO** message will persist until the alarm condition ceases. See Table 11: **SIL**, p. 27. If **SIL** = **YES**, alarms are disabled (no message or output) on startup until the safe area is reached.
- **Alarm High and Low Points, **Ah1** and **ALO****, in the Operations menu determine where alarms will trigger. Alarm hysteresis **ALYS** determines where an alarm condition clears. See Table 11, page 27.
- To Clear an Alarm that is latched or “silence-able” requires the operator to press the **SET** key after the process returns to a safe, or non-alarm condition. Non-latching alarms self-clear. See Table 11: **LAL** and **SIL**, p. 27.

Table 10 (p. 25) and Table 11 (p. 27) illustrate the Series 935A alarm features.

Table 10 - Alarm Functions

	Deviation Alarm		Process Alarm	
	dEnc Deviation normally closed	dEno Deviation normally open	Prnc Process normally closed	Prno Process normally open
ALty Alarm Type →				
Non-Alarm State LED off Alarm Output:				
Alarm State LED on Alarm Output Status:				
Silenced-Alarm State LED off Alarm Output Status:				
Power-Off State LED off Alarm Output Status:				
Function A deviation alarm tracks set point. A process alarm is a fixed value, independent of set point.				
Ahys	Alarm Hysteresis is the change in the process variable (actual) required to clear the alarm relay after an alarm occurs.			



Setting Alarms

Configuration Menu

	Input Type
	Celsius/Fahrenheit
	Input Range Low
	Input Range High
	Output 1 Function
	Output 2 Function
	Display Default
	Alarm Hysteresis
	Alarm Silencing
	Failure Mode
Operations Menu	
	Auto-tune
	Alarm Range High
	PID
	Configuration

1. Plan an alarm strategy. What do you want to happen when an alarm occurs?
2. Wire the appropriate control output, Output 1 or Output 2, and associated switching and annunciators. See p. 42-45 for wiring information.
3. Go to the 935A's Configuration Menu . See p. 16.
4. Set either Output 1 or Output 2 as the output.
5. Set Alarm Type .
6. Set alarm hysteresis .
7. Set alarm latching .
8. Set alarm silencing .
9. Set a failure mode . See p. 36-37.
10. Go to the 935A's Operation Menu. See p.10.
11. Set the alarm high and low and points.
12. Test and adjust the alarm system.
13. Document the alarm settings and system.



CAUTION: Verify, in Table 10, p. 25, the alarm state / alarm output condition you want before making the Alarm Type choice. Failure to do so could result in damage to equipment and property.



WARNING: Do not rely on the Series 935A alarms to provide redundant temperature limit control. Use correctly specified, properly installed temperature limit controls instead. Failure to do so could result in injury, death or damage to equipment and property. (See accompanying Watlow Bulletin 89.4.3.)

To Clear a Series 935A Alarm

In general, press the key to clear a latched or 'silence-able' (=) alarm.

Ultimately, the system process value must return within the safe area for the alarm to remain clear. Non-latching alarms self-clear.

Table 11 (below) and Table 10 (p. 25) illustrate the Series 935A alarm features.

Table 11 - Alarm Functions

LAR Latching alarm	no An unlatched alarm self-clears when actual temperature returns to within the safe area.	YES A latched alarm requires the operator to press the SET key to clear after the actual temperature returns to within the safe area.
SIL Silence alarm	no With this selection, an alarm cannot be silenced at the 935A front panel (unless the alarm is latched [LAR = YES], and the alarm condition no longer exists).	YES With this selection, an alarm can be silenced by pressing the SET key. YES provides automatic alarm silencing on start up.
ALO Alarm Low	A value from input Range Low to Rhi. At the Range Low value, a press displays OFF and Rhi disables.	
RHi Alarm High	A value from ALo to input Range High At the Range High value, a press displays OFF and Rhi disables.	



Learn the Countdown Timer

Configuration Menu

	Input Type
	Celsius/Fahrenheit
	Input Range Low
	Input Range High
	Output 1 Function
✓	Output 2 Function
✓	Display Default
	Alarm Type
	Alarm Hysteresis
•	
✓	Timer Function
✓	Start Timer
✓	Timer Ready Band
✓	Signal Time

Operations Menu

	Auto-tune
✓	Countdown Timer
✓	Idle

- The timer requires Output 1 to work as either a heat or as a cool output.
- The 935A timer is a function of Output 2, which, depending on your unit's model number, can be either switched dc, electromechanical relay, or solid state relay.
- Hours: minutes (hh:mm) or minutes:seconds (mm:ss) choices reside in Output 2 .
- Timer set-up occurs in two locations, in the Configuration Menu and the Operations Menu.
- starts the timer.
- stops the timer.
- choices set up the timer display (see p. 16).
- LED colon flashes when timer runs.
LED colon ON steadily when timer is not running.

Configuration Menu set-up includes: (see p. 16)

- Output 1 : heat or cool .
- Output 2 : timing interval, hours:minutes , or minutes:seconds .
- Timer (Output 2) function can perform one of four possible actions after timing:
 1. Turn ON, also called, "delay ON" .
 2. Turn off, also called, "delay off" .
 3. Toggle ON, also called, "signal ON" .
 4. Toggle off, also called, "signal off" .
- Start timer function choices:
 1. Immediately start .
 2. Start once inside a ready band .
 3. Start once inside a ready band, acknowledging with a press.
 4. Start immediately on control power up without waiting for the Ready Band temp. or a press.
- Ready band width above and below set point: degrees.
- Signal time (if applicable) duration: seconds.

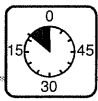
Operations Menu set-up includes: (see p. 10)

- Countdown Time : hours:minutes or minutes:seconds.
- Idle Set Point Type , two choices:
 1. Track primary set point (always controls at the set point value).
 2. Set an idle set point for control when not timing.

The next page presents this information in graphic format with additional detail.

Table 12 - Series 935A Timer Functions/Settings

Configuration Menu				
		Timer set-up available only when = or		
	Choose time in hr:min or min:sec.			
 Output 2 Timer Output Function; Choose one of four possible output actions for the end of the timer / time periods.	 Delay ON Output 2 is ON before timing; OFF during timing; ON after timing.	 Delay OFF Output 2 is OFF before timing; ON during timing; OFF after timing.	 Signal ON Output 2 is OFF before & during timing; ON after timing; then OFF.	 Signal OFF Output 2 is ON before & during timing; OFF after timing; then ON.
	Timer starts immediately on a key press at the normal display without waiting for the Ready Band temperature.			
	Timer only runs in the Ready Band. key starts timer sequence.			
	Ready Acknowledge. key starts timer sequence. must be pressed once inside the Ready Band to start timer at the normal display.			
	Timer starts immediately on control power up without waiting for the Ready Band temperature or a press. See p. 61.			
 Timer Ready Band	 • = 0, Disables Ready feature. • The RDY front panel LED is lit inside Ready Band for all Timer Start functions.			
 Signal Time	Sets the signal time from 00:01 to 99:59 min:sec to run after Timer.			
Operations Menu				
	Timer Function OFF. Countdown Time			
 Idle Set Point	SP Idle 			
	• Idle is set point used when not timing. • If Trac selected Idle is the same as Set Point. • The Set Point value controls the process during the Timer sequence.			



Setting the Countdown Timer

Configuration Menu

In	
Input Type	
C	F
Celsius/Fahrenheit	
rL	
Input Range Low	
rH	
Input Range High	
DEL1	
Output 1 Function	
DEL2	✓
Output 2 Function	
dISP	✓
Display Default	
ALERT	
Alarm Type	
ALYS	
Alarm Hysteresis	
:	
:	
DEL1	✓
Timer Function	
SET	✓
Start Timer	
RDY	✓
Timer Ready Band	
SE	✓
Signal Time	
Operations Menu	
ALERT	
Auto-tune	
DEL2	✓
Countdown Timer	
IDLE	✓
Idle	

1. Plan a timer strategy.
2. Wire the Output 2 control output, associated switching devices and annunciators. See p. 42-45.
3. Go to the 935A's Configuration Menu **CONF9**.
4. Choose the Output 2 **DEL2** function as time; hrs:min **ELH99**, or time; min:sec **ELM95**.
5. Choose a display default **dISP** (see page 16):
 - Actual Temperature only **ACT**
 - Actual; Set Point **ACTSP**
 - Actual; Time **ACTT**
 - Time; Actual **ELACT**
 - Time; Set Point **ELTSP**
6. Choose a Timer Output Function **ELM99**:
 - Delay ON **DELON**
 - Delay off **DELof**
 - Signal ON **SEON**
 - Signal off **SEof**
7. Choose a start timer **SET** function; either immediate **IMPd**, ready band **RDY**, Ready Acknowledge **RDYR**, or Power **PLWR**.
8. If you chose **RDY** or **RDYR**, then select a ready band **RDY** value.
9. If you chose **SEON** or **SEof**, then select a signal time **SE** value.
10. Go to the 935A's Operation Menu.
11. Set the countdown time **ELM99**.
12. Choose the idle set point **IDLE** to track **ELRAC** the primary set point, or select a separate idle set point value between the range high **rH** and range low **rL** values.
13. Run the system, and test the timer start with a **SET** press.
14. Document the timer settings and system.



Timer Example

Convection Oven Application

Scenario

A master chef bakes bread at 350°F for 30 minutes. He wants the oven at the proper temperature with an indication when it is ready to begin baking. He isn't concerned if the oven is 10° cool at first. After he loads the oven, the chef wants to start the countdown time by pressing a key. When the baking time is complete, he wants a 10 second audible indication that the bread is done.

Recommended Control

A Series 935A-1CD0-000G control.

- Switched dc Output 1 wired to a dc input solid state relay (SSR) switches the heaters.
- Electromechanical relay Output 2 wired to an AC audible indicator provides “done” indication.

Configuration Menu Set-up

CLF	=	0F	°F
DISP	=	Act	After a SE press, actual temperature appears for 15 seconds.
OUT1	=	HEAT	Heating output
OUT2	=	TIME	Time; minutes:seconds
TEMP	=	SETR	Output 2 turns ON briefly at the end of the timing cycle.
SETP	=	RDYB	Timer waits to countdown until temperature deviation from set point < RDY value and the SE key is pressed.
RDY	=	10	Ready band; 10°F
SE	=	10	Output 2 turns ON for 10 sec. at the end of the timing cycle.

Operations Menu Set-up

TEMP	=	3000	Bake time; 30 minutes
IDLE	=	75	The set point temperature before a timing cycle starts and after a timing cycle completes.
Set Point	=	350	°F

Operator/Control Actions

- With the oven “idling” at 75°F, the chef starts the preheat cycle with a **SE** press. The display immediately shows 30:00 with the colon ON steadily. The RDY LED is off. Series 935A begins to control to the 350°F bake set point.
- As the actual oven temperature increases to within the Ready Band at 350°F ±10°F, the RDY LED turns on. The chef loads the oven and presses **B** to acknowledge the Ready Band and thereby start the bake cycle.
- Time starts counting down. Actual temperature displays for 15 seconds after the **SE** key is press. Then time displays with the colon flashing.
- If temperature deviates out of the Ready Band (less than 340°F or more than 360°F), timer countdown will pause, but will continue as soon as temperature re-enters the ready band.
- When time reaches 00:00, Output 2 turns on for 10 seconds sounding the audible indicator. The chef can stop the audible indicator by pressing **SE**. The Series 935A then automatically shifts to the 75°F idle set point.



Auto-tuning

Operations Menu

AUT ✓

Auto-tune

ALD

Alarm Range Low

AH1

Alarm Range High

CDT

Countdown Timer

IDLE

Idle

LSR

Local / Remote

PID

PID

CONF

Configuration

NOTE:

AUT is not visible at factory default.



CAUTION:

Successful Series 935A auto-tuning requires 3 oscillations thru the 90% set point in 85 min. or less. If the system cannot perform the oscillations in that time, the control will revert to the previous PID values.

NOTE:

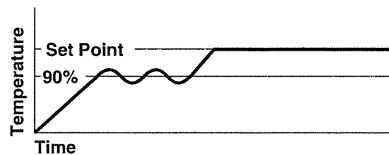
Manual tuning is a slow procedure, taking from minutes to hours to obtain optimum value.

Auto-tuning

Auto-tune automatically sets PID parameters for your system.

1. Press **ESC** and **ESC** for three seconds.
2. You'll see **AUT**.
3. Press and hold **ENT**, then select **YES** with **UP** or **DOWN**. **TUNE** will flash to indicate auto-tuning. Display reverts to normal after auto-tuning.
4. **AUT** = **NO** stops auto-tuning.

Figure 7 - Auto-tuning the Series 935A



Auto-tuning occurs at 90% of set point in less than or equal to 85 minutes.

Manual Tuning

For optimum performance, tune the Series 935A to your thermal system. The settings here are for a broad spectrum of applications; your system may have different requirements.

Tune heating outputs at a set point above ambient temperature.

Tune cooling outputs at a set point below ambient temp.

1. Apply power to the 935A and enter a set point. In the Operations Menu, **AUT** must = **NO**. Begin with these Configuration Menu settings:
PB h = **1**, **IE** = **000**, **DE** = **000**,
CT h = **50**, **CAL** = **0**.
2. Proportional Band Adjustment: Gradually increase **PB h** until the upper display temp. stabilizes at a constant value.
3. Integral Adjustment: Gradually decrease **IE** from 30.00 until the display temperature begins to oscillate or "hunt." Then slowly increase **IE** until the upper display stabilizes again near set point.
4. Cycle Time Adjustment: Set **CT h** as required. Faster cycle times sometimes achieve the best system control. However, if a mechanical contactor or solenoid is switching power to the load, a longer cycle time will minimize wear on relays.
5. Derivative Adjustment: Increase **DE** to 0.10 minute. Then raise set point by 20° to 30°F, or 11° to 17°C. Observe approach to set point. If load temperature overshoots, increase **DE** by 0.50 minute. Raise set point by 20 to 30°F, or 11 to 17°C and watch approach again. Repeat until system rises to new set point appropriately.
6. Calibration Offset Adjustment: Enter the **CAL** offset value you want. Calibration offset adds or subtracts degrees from the value of the input signal.



Fine Tune the PID Settings

PID Menu

Set up Heat:

Pb h	✓
Proportional Band	
hys h	✓
Hysteresis	
ct h	✓
Cycle Time	
db	✓
Dead Band	

Set up Cool:

Pb c	✓
Proportional Band	
hys c	✓
Hysteresis	
ct c	✓
Cycle Time	

Set up General:

it	✓
Integral	
de	✓
Derivative	
cal	✓
Calibration Offset	

1. Set **Pb h** and **ct h** in degrees.
2. If Proportional Band Heat **Pb h** = 0, Set Hysteresis Heat **hys h**. The Series 935A will provide on/off control with the hysteresis value selected, and no proportioning action.
3. Proportional Bands should be decreased for tighter control but increased to eliminate oscillations.
4. Cycle Time Heat **ct h** is limited to a minimum of 5.0 seconds for the electromechanical relay to help reduce wear. The electromechanical relay (D, Output 2) is not recommended for PID control. It is warranted to 100,000 contact closures only. Alarm or on/off control are appropriate applications for the Series 935A's electromechanical relay output.
5. Set Dead Band **db** to adjust the effective cool set point above the primary set point by the dead band value in degrees. In cool/heat applications, dead band prevents continuous cool output action by creating a buffer between heating and cooling output action.
6. Set **Pb c** and **ct c** in degrees.
7. If Proportional Band Cool **Pb c** = 0, Set Hysteresis Heat **hys c**. The Series 935A will provide on/off control with the hysteresis value selected, and no proportioning action.
8. Proportional Bands should be decreased for tighter control but increased to eliminate oscillations.
9. Cycle Time Heat **ct c** is limited to a minimum of 5.0 seconds for the electromechanical relay to help reduce wear. The electromechanical relay (D, Output 2) is not recommended for PID control. It is warranted to 100,000 contact closures only. Alarm or on/off control are appropriate applications for the Series 935A's electromechanical relay output.
10. Set Integral **it** to eliminate droop in the system. Lower the value for more droop reduction. Adjustable from 0 to 99.9 minutes / repeat.
11. Set Derivative **de** to prevent overshoot. Increasing the value slows the approach to set point. Adjustable from 0 to 9.99 minutes.
12. Calibration Offset **cal** eliminates the difference between the displayed process temperature and the actual process temperature value.



Calibrating the 935A

Calibration Menu

tc50 ✓
tc50

tc00 ✓
tc00

tc ✓
tc

r15 ✓
r15

r380 ✓
r380

r5t ✓
rst

Quick Calibration Restore:

Press all three keys simultaneously until **tc50** appears in the display, press **NO** once and **r5t** will appear in the display. Press and hold **YES**, the display will show **no**, press **NO** to change display to **YES**. Press and hold **NO** and **YES** for 3 seconds to exit the **CAL** menu.

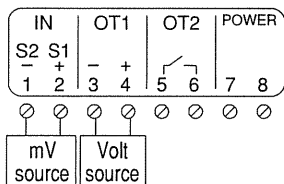
NOTE: Restore Factory Calibration

r5t = YES restores factory calibration values to all calibration prompts.

Calibration requires a precision millivolt source with thermocouple compensation, an adjustable 0-10 volt source, and a decade resistance box.

- **tc50** and **tc00** calibrate the thermocouple span.
- **tc** calibrates the ambient compensation.
- **r380** and **r15** calibrate the RTD span.
- 0V is required when calibrating **tc00** and **r15** for remote set point calibration.
- 5V is required when calibrating **tc50** and **r380** for remote set point calibration.
- When calibrating, calibrate all points for consistency in results.
- Allow the unit to warm up for 15 minutes before calibrating.

Figure 8a - Thermocouple Calibration



tc50

mV source = 50.000mV
Volt source = 5V

- Store TC counts at 50.000mV
- Store 5V remote set point counts for use with TC

tc00

mV source = 0.000mV
Volt source = 0V

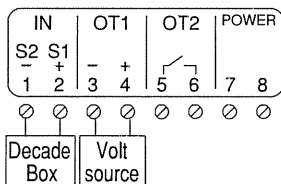
- Store TC counts at 0.000mV
- Store 0V remote set point counts for use with TC

tc

mV source = Temp. Compensation
Volt source = 0V

- Store ambient counts at 32° F. Type J.

Figure 8b - RTD Calibration



r15

Decade Box = 15.00 ohms
Volt source = 0V

- Store low end RTD counts
- Store 0V remote set point counts for use with RTD

r380

mV source = 380.00 ohms
Volt source = 5V

- Store high end RTD counts
- Store 5V remote set point counts for use with RTD

r5t **no**
YES

- Restore factory calibration

Calibrating the 935A and Remote Set Point Input

Thermocouple and Remote Set Point Input Field Calibration Procedure

Equipment Required:

- Type "J" Reference Compensator with reference junction at 32°F/0°C, or Type "J" Thermocouple Calibrator set at 32°F/0°C.
- Precision millivolt source, 0-50mV min. range, 0.01mV resolution.

Set Up:

1. Connect 100-240~ (ac), or 24-28V $\approx$ (ac/dc) to Terminal 7 and Terminal 8.
2. Connect the millivolt source to Terminal 1 negative and Terminal 2 positive.
3. Connect voltage source to Terminal 3 negative and Terminal 4 positive.
4. Apply power to the unit and allow it to warm up for 15 minutes.

Move to the Calibration Menu:

1. Press and simultaneously for 3 seconds.
2. Press or until **TEMP** is displayed.
Press and hold – press or to select **YES**, then release .
3. Press or until **LR9** is displayed.
Press and hold . Press or 8 times (display shall be blank).

Calibration: (Thermocouple)

1. Press and hold , , and simultaneously for 3 seconds until **LR50** is displayed.
2. Set the mV source to 50.00mV $\approx$ (dc). Set the voltage source to 5.00V $\approx$ (dc). Allow 10 seconds for sources to stabilize. Press and hold . Press or until **YES** appears. Release .
3. Press - **LR00** shall be displayed.
4. Set the mV source to 0.00 mV $\approx$ (dc), set voltage source to 0.00V $\approx$ (dc). Allow 10 seconds for sources to stabilize. Press and hold . Press or until **YES** appears. Release .
5. Press . **LR** shall be displayed.
6. Set the MV source to 0.00 mV (if using a temperature compensator). Set calibrator to 32°F/0°C.
Set voltage source to 0.00V. Allow 10 seconds for sources to stabilize.
Press and hold . Press or until **YES** is displayed. Release .

Calibration: (RTD)

Equipment Required:

- Precision Resistance Box with 0.01 Ω Resolution.
1. Remove thermocouple wires from Terminal 1 and Terminal 2.
 2. Connect S2 to terminal 1. Connect S1 to Terminal 2.
 3. Press . **LR15** shall be displayed.
 4. Connect voltage source to Terminal 3 negative and Terminal 4 positive.
 5. Set the Decade box to 15.00 Ω , set the voltage source to 0.00V (Allow 10 seconds for sources to stabilize). Press and hold .
Press or until **YES** appears. Release .
 6. Press - **LR80** shall be displayed.
 7. Set the decade box to 380.00 Ω , set the voltage source to 5.00V. (Allow 10 seconds for sources to stabilize). Press and hold .
Press or until **YES** appears. Release .
 8. Press and hold and for 3 seconds to Exit calibration menu.



Errors and Troubleshooting

Configuration Menu

in

Input Type

C F

Celsius/Fahrenheit

RL

Input Range Low

RH

Input Range High

DE 1

Output 1 Function

DE 2

Output 2 Function

DISP

Display Default

ALTY

Alarm Type

ALYS

Alarm Hysteresis

LRE

Alarm Latch

SIL

Alarm Silencing

FRIL ✓

Failure Mode

TIME

Timer Function

STRT

Start Timer

RDY

Timer Ready Band

SE

Signal Time

SPLO

Set Point Lockout

LTAG

Lockout Tag

Set up an input failure operation mode at the **FRIL** prompt in the **CONF9** menu; choose bumpless transfer **BPLS** for smooth output action transition to percent power control, or select a percent power output value.

FRIL **BPLS**

Bumpless Transfer

when errors occur, the control output will continue at a percent output learned while stable. Default = **BPLS**.

-100 **100**

Percent Power

(-100% to +100% , depending on heat/cool output configuration). The control will assume a specific output power when input errors occur.

- All except one of the possible displayed error messages are input related.
- If you see **ERS**, cycle power to the controller. If the error persists, call the factory.
- Be aware of the difference between U.S and European thermocouple color/colour codes.
- Reversed polarity input leads is one of the most common errors.
- Incorrect software input choice at the Configuration Menu **CONF9** input **in** prompt is another common error.

When calling the factory for help, please have:

1. The model number of the control.
2. A photocopy of pages 55 to 62 with the settings from your control, if possible.
3. Specifications of devices directly interfaced with the control.

Table 13 - Error Codes and Actions

Display	Probable Cause	Recommended Action	
	Reversed thermocouple connection + to -.	Change the sensor leads on Terminals 1 and 2.	A-D under flow
	Sensor type mismatch or open RTD.	Go to In prompt, check selection (see p. 20), or check RTD, replace as necessary.	Sensor under range
	Sensor type mismatch.	Go to In prompt, check selection (see p. 20).	Sensor over range
	Open Thermocouple, bad connection, or broken wire.	Check the sensor, replace as necessary.	A-D over flow
	Electrical noise.	Cycle power to system. See if error clears. Check system for electrical interference.	
	Control is inoperable.	Check for line voltage at terminals 7 and 8.	

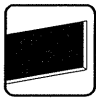
To Troubleshoot Sensor

- Remove sensor wires from Terminals 1 and 2.
- For a thermocouple sensor Series 935A, place a jumper wire on Terminals 1 and 2. Control should display the ambient temperature at the back of the control.
- For an RTD sensor Series 935A, place a 110 +/- 10Ω resistor on Terminals 1 and 2. The control should read 100Ω = 32°F, 110Ω = 77°F, 120Ω = 127°F.
- An RTD sensor Series 935A can be configured in software as if it were a thermocouple unit, and then tested as above.
- You can restore factory calibration  see p. 34-35.

Table 14 - Troubleshoot Control Outputs

When indications such as significant differences between set point and actual temperatures point to no output action, check output configurations as described on p. 23. Check wiring, p. 44.

Output	Measure Terminals	Load-on State	Load-off State
"C" Output 1	3 & 4	LED 1 on 3.0 to 7.0V _{DC} (dc)	LED 1 off 0.0V _{DC} (dc)
"C" Output 2	5 & 6	LED 2 on 3.0 to 7.0V _{DC} (dc)	LED 2 off 0.0V _{DC} (dc)
"D" Output 2	5 & 6	LED 2 on 0V _{DC} (dc) Load sees line voltage	LED 2 off line voltage. Load sees 0V _{DC} (dc)
"K" Output 2	5 & 6	LED 2 on <2V _{DC} (dc) Load sees line voltage	LED 2 off line voltage Load sees 0V _{DC} (dc)



Mounting

Figure 9- Panel Cut-out Dimensions

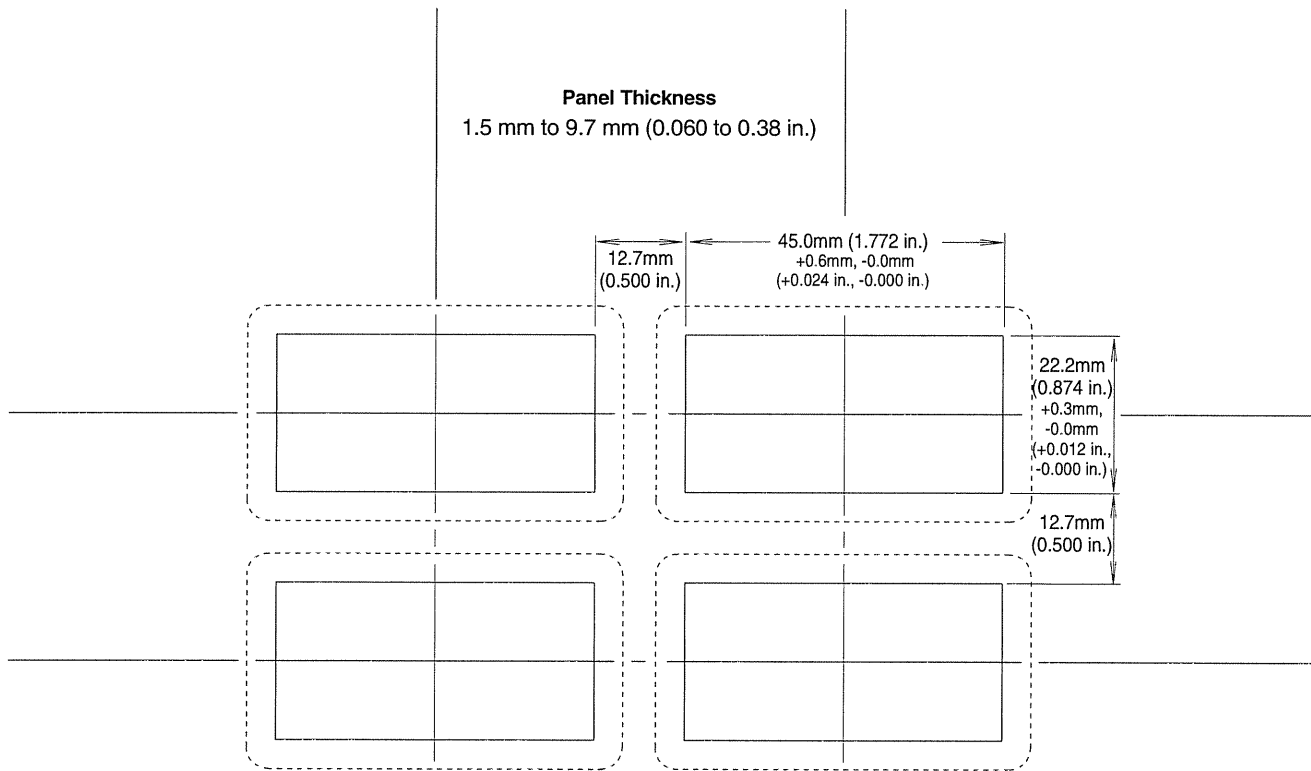
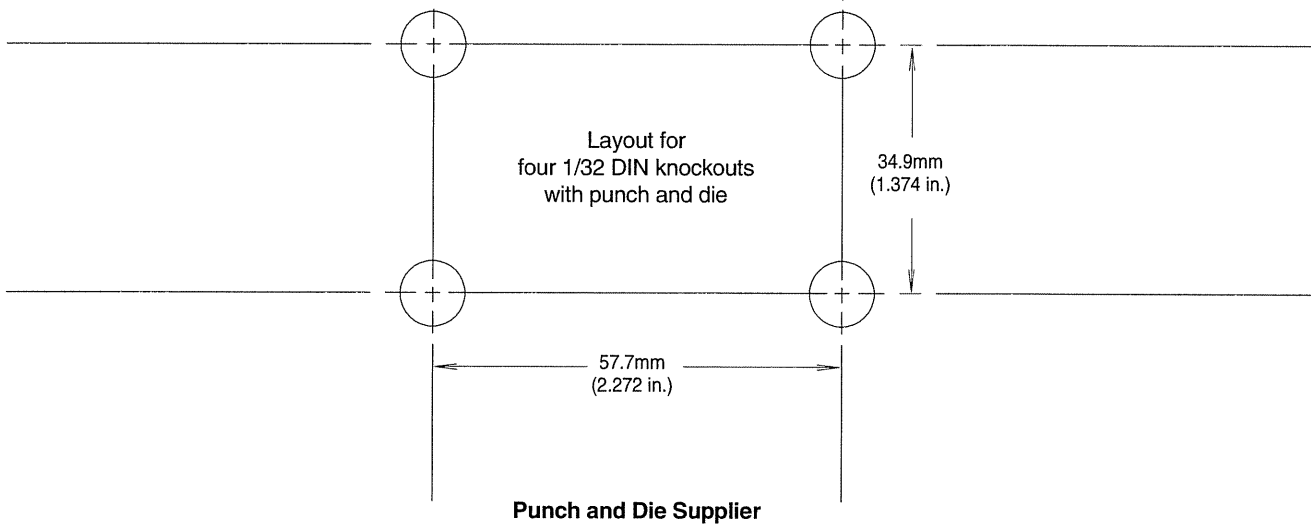


Figure 10- Mounting Layout for Knockouts

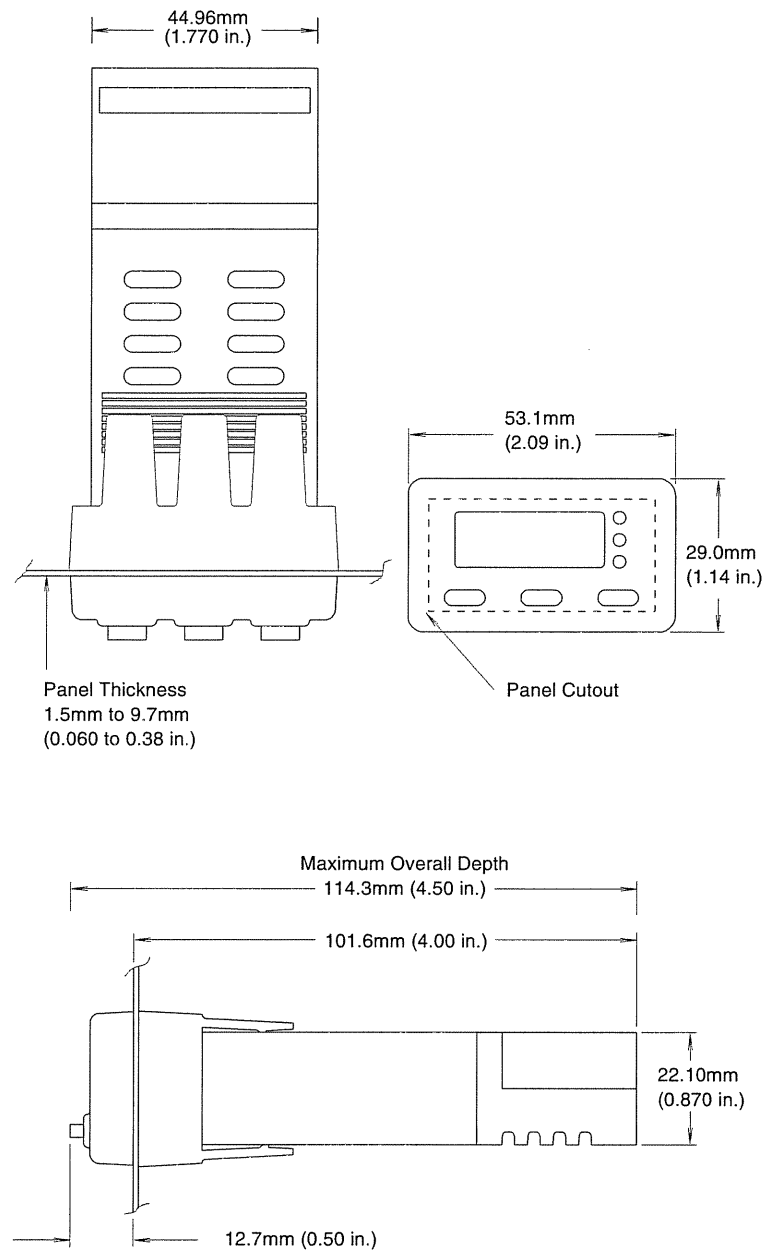


Greenlee Textron, Inc., Phone: 1-800-435-0786.
Catalog Number: 50740180; Available: 4-6 weeks, Greenlee distributor.



Dimensions

Figure 11- Series 935A Dimensions





Installation Procedure

1. Make a panel cutout using the dimensions in Figure 9, p. 38.
2. Insert the 935A into the cutout. Check to see that the gasket is not twisted. Make sure the rounded side of the D-shaped external case gasket faces the panel surface, and the gasket is fully seated in its bezel channel. See Figure 12.
3. While pressing the bezel firmly against the panel, slide the mounting collar over the back of the control. The tabs on the collar must line up with the mounting ridges on the case for secure installation. See Figure 12 again.
4. Slide the collar firmly against the back of the panel, getting it as tight as possible. Make sure you cannot move the case within the cutout, if you can, you do not have a IP65/NEMA 4X seal!
5. Make sure you have a tight seal. Use your thumb to lock the tabs into place while pressing the case from side to side. Don't be afraid to apply enough pressure to install the control. The tabs on each side of the collar have teeth which latch into the ridges. See Figure 12. Each tooth is staggered at a different depth (from the front) so only one of the tabs on each side is ever locked into the ridges at any time.
6. Look at Figure 13; you see that the tabs on one side of the collar correspond with those on the opposite side. Be sure only the two corresponding tabs are locked in the ridges at the same time. If the matching tabs are not holding the case, no IP65/NEMA 4X seal exists. Make a visual check, or use your finger nail to pull out on each tab. The space between the bezel and panel must be 0 to 0.48 mm (0 to 0.019 in.).

Collar Removal

Slide a thin, wide tool (putty knife) under all three mounting tabs, top then bottom, while pushing forward on the back of the case.

Figure 12- Mounting, Case Top View and Collar Cross Section.

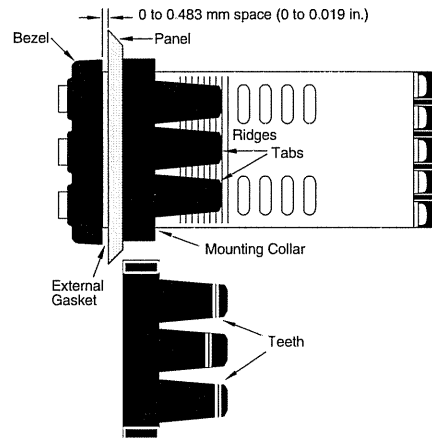
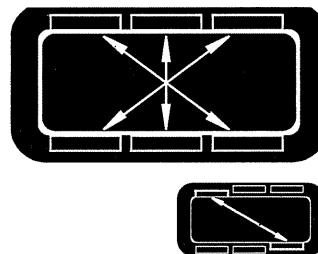


Figure 13- Case Rear View and IP65/NEMA 4X Seal Example



NOTE: To guarantee a proper IP65/NEMA 4X seal, make sure the gasket between the panel and the rim of the case is not twisted and is seated properly. Press firmly.

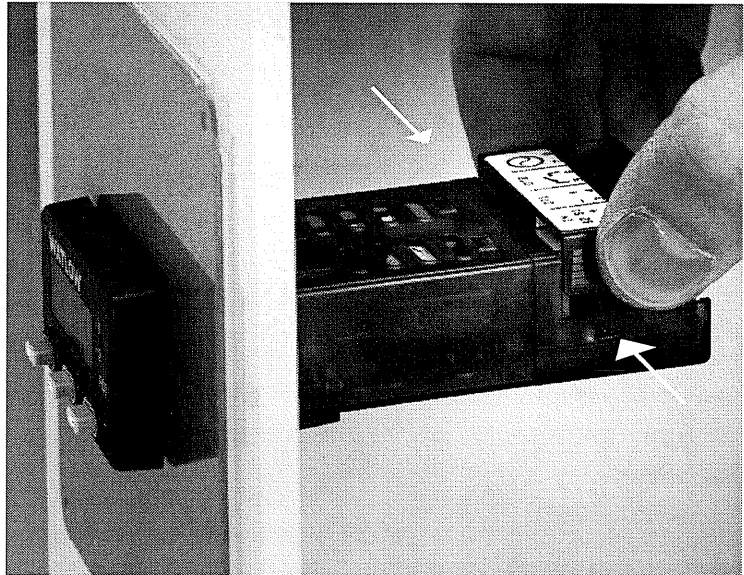
NOTE: Make sure the rounded side of the D-shaped external case gasket faces the panel surface, and the gasket is fully seated in its bezel channel. See Figure 12.



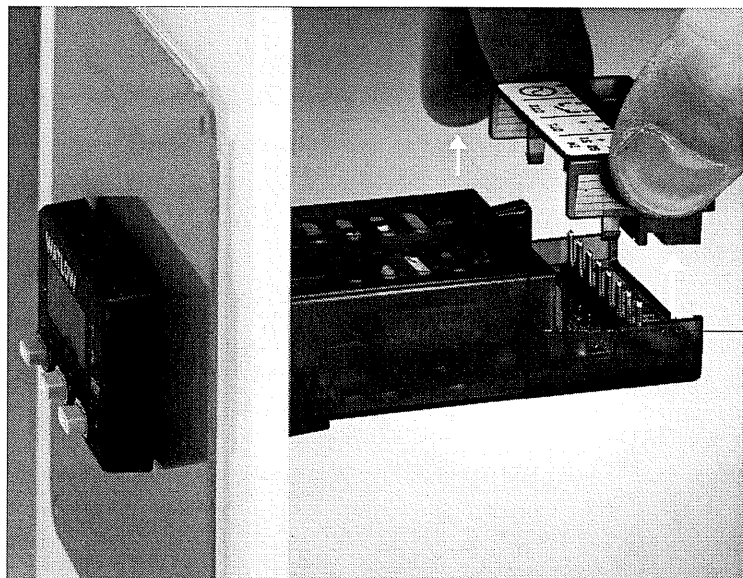
Terminal Block Removal

Figure 14- Terminal Block Removal Procedure

1. Press in on sides of cover to release the terminal cover hooks.



2. Move your grip rearward slightly, then lift the terminal cover straight up.





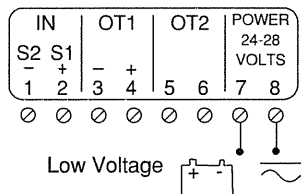
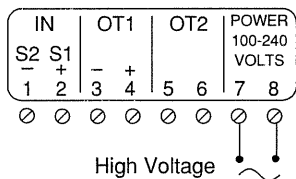
Wiring a 935A

Figure 15 - Wiring the Series 935A

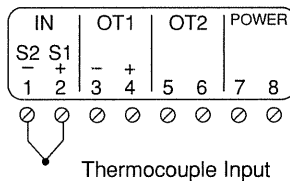
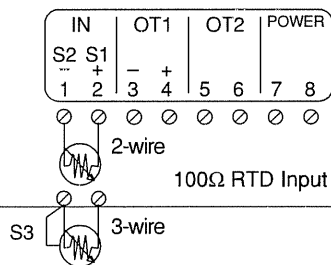
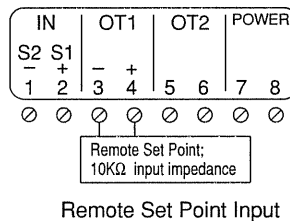


WARNING: All electrical wiring and fusing must conform to local and national electric codes. Contact local authorities for further information. Failure to comply with electric codes could result in injury or death, or damage to property.

Power Wiring



Input Wiring



CAUTION: Using grounded thermocouples with non-isolated output switching devices could introduce ground loops into the control system, and possibly damage the controller and product.

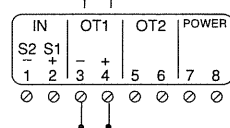
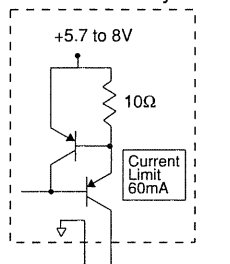
NOTE: Torque terminals to 1.36 Nm (12 in lbs).



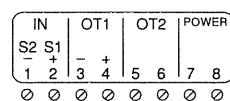
WARNING: All electrical wiring and fusing must conform to local and national electric codes. Contact local authorities for further information. Failure to comply with electric codes could result in injury or death, or damage to property.

Output 1 Wiring

Internal Circuitry



Output 1; Switched DC; "C"

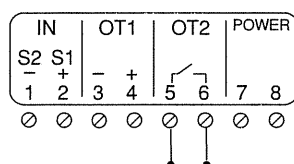


See Caution

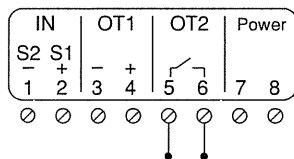
60 to 70Ω, 0.5w resistor

Output 1; Front Panel Lock

Output 2 Wiring

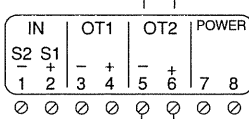
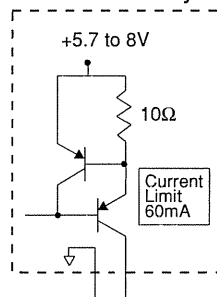


Output 2; Solid State Relay; "K"



Output 2; Electromechanical Relay; "D"

Internal Circuitry



Output 2; Switched DC; "C"



CAUTION: Failure to install a 60 to 70Ω, 0.5w resistor across the customer-supplied Front Panel Lock switch will cause the panel to lock out even when the switch is open. Injury to personnel, or damage to equipment or property could result.



WARNING: When Output 1 is a Front Panel Lock **FPL**, the output is energized! Do not connect a power switching device to Output 1; injury or death, or damage to equipment or property could result.

NOTE:

Switching inductive loads (relay coils, solenoids, etc.) with the mechanical relay or solid-state relay output options requires using an R.C. suppressor. Watlow carries the R.C. suppressor Quencharc brand name, which is a trademark of ITW Pakron. Watlow Part No. 0804-0147-0000.

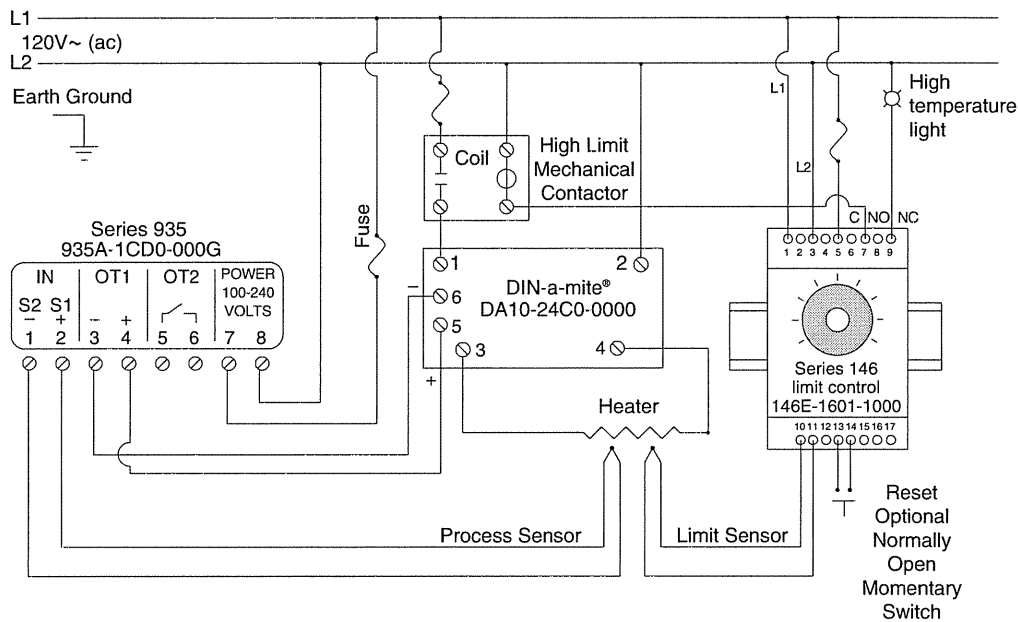


System Wiring Examples

Figure 16 - Series 935A System Wiring Examples



WARNING: All electrical wiring and fusing must conform to local and national electric codes. Contact local authorities for further information. Failure to comply with electric codes could result in injury or death, or damage to property.

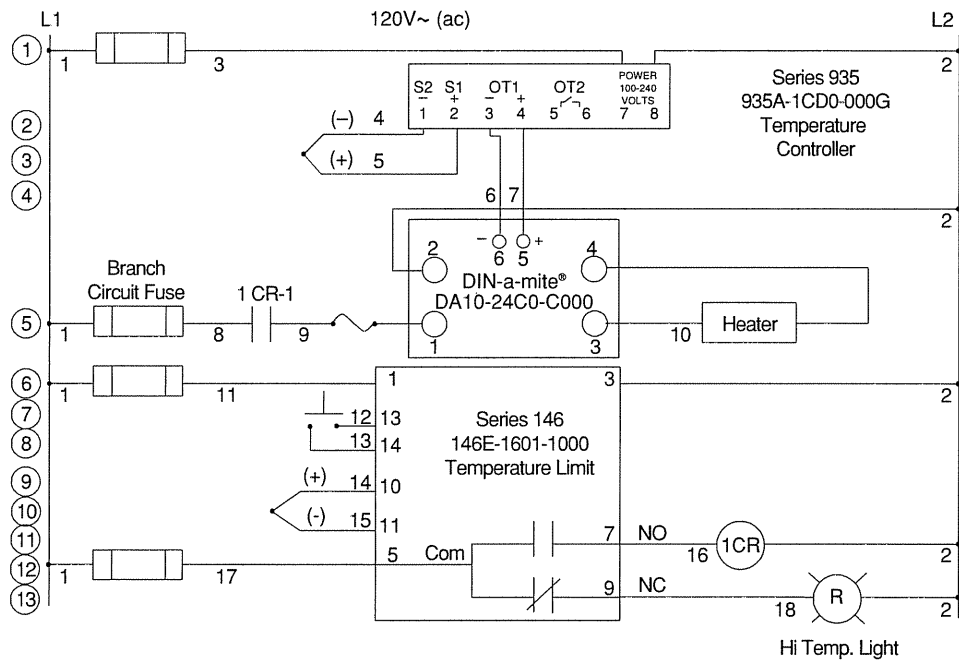


CAUTION: Using grounded thermocouples with non-isolated output switching devices could introduce ground loops into the control system, and possibly damage the grounder and product.

Figure 17 - Series 935A Ladder Diagram Wiring Example



WARNING: All electrical wiring and fusing must conform to local and national electric codes. Contact local authorities for further information. Failure to comply with electric codes could result in injury or death, or damage to property.





Glossary

Alarm

A condition, generated by the controller, indicating that the process has exceeded or fallen below the set or limit point.

Alarm Hysteresis

A change in the process variable required to re-energize the alarm output.

Ambient Temperature

Temperature surrounding the components of a thermal system.

Auto-tune

Automatically sets PID values to fit a particular thermal system.

Bumpless Transfer

When transferring from auto to manual operation, the control output(s) will maintain the same output level.

Calibration

Adjusting an instrument to a known value.

Configuration Menu

The second software sub menu of the Series 935A Operations Menu; provides a location to set inputs, ranges, output types, alarm type, timer function, failure mode, and lockout types.

Control Mode

The method of control, i.e. ON/OFF, time proportioning, PI, PID or manual.

Cycle Time

Time required for a control to complete one ON through OFF cycle.

Dead Band

Adjusts the effective cool set point above the primary set point by the dead band value in degrees. In cool/heat applications, dead band prevents continuous cool output action by creating a buffer between heating and cooling output action.

Delay OFF

A Series 935A timer output (Output 2) choice that turns the output OFF at the end of the countdown timer time.

Delay ON

A Series 935A timer output (Output 2) choice that turns the output ON at the end of the countdown timer time.

Derivative

Limits the rate of change of the process to eliminate overshoot in slow or lagging loads ($de=ra$).

Deviation Alarm

An offset value which tracks the set point. Process changes beyond this value register an alarm condition.

DIN-a-mite®

Watlow family of DIN rail-mounted SCR power controllers.

Droop

The difference between the set point and actual values once the system stabilizes.

Hysteresis

A change in the process variable required to re-energize the control or alarm output.

Idle Set Point

Desired control value before and after timing period.

Integral

Accumulates error to eliminate offset or droop ($It=1/re$).

Local Set Point

Primary set point, not remote.

ON/OFF

Control by turning the output full ON until set point is reached, and then turning OFF until the process error exceeds the hysteresis.

Operations Menu

Series 935A software menu; provides a location to start auto-tune, set alarm points, set countdown time, choose an idle or normal set point type, choose a local or remote set point input, and to go to the PID or Configuration Menus.

Overshoot

The amount a process variable exceeds set point before stabilizing.

Percent Power Control

Open loop control with output power set at a particular level.

PID

(Proportional, Integral, Derivative). A control mode: proportional action sets the system, integral reduces droop, derivative reduces overshoot and undershoot.

PID Menu

The first software sub menu of the Series 935A Operations Menu; provides a location to manually set values for proportional band, hysteresis, cycle time, integral, derivative, and calibration offset.

Process Alarm

A fixed value independent of set point. Process changes beyond this value register an alarm condition.

Process Error

The difference between the set point and the actual process.

Proportional

Output effort proportional to the error from set point. If the proportional band is 20° and the process is 10° below set point, the heat proportioned effort is 50%. The lower the Pb value, the higher the gain.

Proportional Band

A range in which a control's proportioning function is active (See PID).

Range

The area between two limits in which a quantity or value is measured. Usually expressed in terms of lower and upper limits.

Ready Acknowledge

A Series 935A countdown timer start choice that pre-initiates the timer with a down key press, and then starts it with a SET press when the actual temperature is within the Ready

Ready Band

Thermal area above and below primary set point in which the timer will count down.

Relay, Electromechanical

A power switching device that completes or interrupts a circuit by physically moving electrical contacts. Not recommended for PID control.

Remote Set Point

A 0-5V_{DC} (dc) input from another controller or other source.

RTD

Resistive Temperature Detector. A sensor whose resistance increases with increasing temperature. Set Point
The desired process value programmed into a control.

Signal

Any electrical transmittance that conveys information.

Signal OFF

A Series 935 timer output (Output 2) choice that toggles the output OFF, then ON at the end of the countdown timer cycle for a period equal to the signal time.

Signal ON

A Series 935 timer output (Output 2) choice that toggles the output ON, then OFF at the end of the countdown timer cycle for a period equal to the signal time.

Signal Time

Time duration the timer output will turn ON or OFF after a complete timing period.

SCR

Silicon controlled rectifier. A solid state device, or thyristor, with no moving parts, that is used in pairs to control AC voltages within one cycle. SCRs control voltage from a power source to the load by burst firing (also called zero-cross firing) or phase angle firing.

SSR

Solid State Relay. A solid state switching device that switches current ON and OFF. It has no moving parts.

Thermal System

A regulated environment consisting of a heat source, heat transfer medium, sensing device, a control instrument, and a redundant control device (limit).

Thermocouple

A temperature sensing device made by joining two dissimilar metals. This junction produces an electrical voltage in proportion to the difference in temperature between the hot junction and lead wire connection to the sensing device (cold junction).

Undershoot

The amount a process variable falls below set point before stabilizing.



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- Height
- Length
- Width

Specifications

Specifications (2191)

Control Mode

- Auto-tune PID.
- PID, PD, PI, on/off.
- Countdown timer; hours:minutes, minutes:seconds.
- Timer output modes; Delay-off, Delay-on, Signal-off, Signal-on.

Agency Approvals

- UL/C-UL 508 Listed, File #E102269.
- IP65/NEMA 4X² rated front panel.
- CE approved:
 - 89/336/EEC Electromagnetic Compatibility Directive: EN61326 Industrial Immunity, Class A Emissions
 - 73/23/EEC Low-voltage Directive: EN 61010-1: 1993 Safety.

Operator Interface

- Single, seven-segment digital display, factory selectable red or green.
- Outputs/operation annunciators, three discrete LEDs.
- Three tactile feedback momentary switches.
- Front panel lock dry contact closure disables front panel operation.

Accuracy

- $\pm 0.25\%$ of span, ± 1 LSD, or
- Types S and T thermocouple @ $< 200^{\circ}\text{C}$, $\pm 0.32\%$ of span, ± 1 LSD, typical.

Ambient Rejection

- $< 0.15^{\circ}\text{C}/^{\circ}\text{C}$ rise in ambient, or
- Types S and T thermocouple, @ $< 0.47^{\circ}\text{C}/^{\circ}\text{C}$ rise in ambient typical.

Sensors/Inputs

- Sensor input sampling rate: 10 samples/second (10Hz).
- Type E, J, K, N, S and T thermocouple, grounded or ungrounded junction.
- RTD, 100 Ω platinum two-wire, DIN curve
- Remote set point input, field-selectable, 0-5V $\approx$ (dc), scalable, 10k Ω input impedance. (Remote Input Option A only.)
- Remote timer start dry contact closure initiates timer start. (Remote Input Option B only.)

Input Range

Specified temperature ranges represent the controller's operational span.

Thermocouple

Type E	-200 to 799 $^{\circ}\text{C}$ (-328 to 1470 $^{\circ}\text{F}$)
Type J	0 to 750 $^{\circ}\text{C}$ (32 to 1382 $^{\circ}\text{F}$)
Type K	-200 to 1250 $^{\circ}\text{C}$ (-328 to 2282 $^{\circ}\text{F}$)
Type N	0 to 1250 $^{\circ}\text{C}$ (32 to 2282 $^{\circ}\text{F}$)
Type S	0 to 1450 $^{\circ}\text{C}$ (32 to 2642 $^{\circ}\text{F}$)
Type T	-200 to 350 $^{\circ}\text{C}$ (-328 to 662 $^{\circ}\text{F}$)

RTD Resolution Platinum 0.00385 Curve

1 $^{\circ}$	-200 to 700 $^{\circ}\text{C}$ (-328 to 1292 $^{\circ}\text{F}$)
0.1 $^{\circ}$	-128.8 to 537.7 $^{\circ}\text{C}$ (-199.9 to 999.9 $^{\circ}\text{F}$)

Control Output

- Output update rate: 1/second (1Hz).

1 Output/Remote Input

- Switched dc logic signal, 6V $\approx$ (dc) @ 60mA nominal, short circuit protected, non-isolated. (Watlow DIN-a-mite[®] power controller compatible).

2 Output

- Switched dc logic signal, 6V $\approx$ (dc) @ 60mA nominal, short circuit protected, non-isolated (Watlow DIN-a-mite[®] power controller compatible).
- Electromechanical¹ relay, Form A, 2A @ 30V $\approx$ (dc) or, 240V $\sim$ (ac), with-out contact suppression³. (Remote Input Option A only.)
- Solid-state relay, Form A, 0.5A, 24 to 264V $\sim$ (ac), without contact suppression³. Off-state output impedance 31M Ω . (Remote Input Option A only.)

Output Cycle Time

- Switched dc and solid-state relay; 5.0 second default, 0.1 second minimum.
- Electromechanical relay; 30.0 second default, 5.0 second minimum.

Line Voltage/Power

- 100-240V $\sim$ (ac) $\pm 10\%$, -15% ; (85-264V $\sim$ [ac]) 50/60Hz, $\pm 5\%$.
- 24-28V $\approx$ (ac/dc) $\pm 10\%$, -15% ; (20-31V $\approx$ [ac/dc]) 50/60Hz, $\pm 5\%$. (Remote Input Option A only.)
- Fused internally (factory replaceable only) time-lag type, 2A, 250V.
- Power consumption 6VA maximum.
- Data retention upon power failure via non-volatile memory.
- Switching supply speed 45kHz, $\pm 5\text{kHz}$.

Operating Environment

- 0 to 65 $^{\circ}\text{C}$ (32 to 149 $^{\circ}\text{F}$).
- 0 to 90% RH, non-condensing.

Storage Temperature

- -40 to 85 $^{\circ}\text{C}$ (-40 to 185 $^{\circ}\text{F}$).

Terminals

- Touch-safe set screw type, accepts 0.5 to 4mm² (22 to 12 AWG wire). Torque to 0.1 Nm (4.5 in lbs).

Controller Weight

- 113 g (4.0 oz).

Shipping Weight

- 207 g (7.3 oz).

These specifications are subject to change without prior notice.



Ordering a 935A

Ordering Information (2192)

Single thermocouple or RTD (DIN) input, dual output, single display
temperature control with time function and four digit display

935 -1C - 0

Remote Inputs

- A = Remote set point input, or front panel lock input in place of output #1
- B = Separate input for remote timer start, or front panel lock

Output 1/Remote Input

- C = Switched dc, logic signal, non-isolated; (Watlow *DIN-a-mite*® power controller compatible)
(Optionally used for remote set point input; or front panel lock input for Remote Input A option only.)

Output 2

- C = Switched dc, logic signal, non-isolated (Watlow *DIN-a-mite*® power controller compatible)
- D = Electromechanical relay ¹, Form A, 2A, 240V~ (ac), without contact suppression ³ (Remote Input A option only.)
- K = Solid-state relay, 0.5A, 24-264V~ (ac), without contact suppression ³ (Remote Input A option only.)

Power Supply

- 0 = 100 to 240V~ (ac) nominal (high voltage)
- 1 = 24 to 28V~ (ac/dc) nominal (low voltage) (Remote Input A option only.)

Custom Options

- 00 = None
- AA = No Watlow logo
- XX = Custom label or parameters

Display

- R = Red displays
- G = Green displays

Table 15 - Input Range Information

J t/c:	0	to	750°C	or	32	to	1382°F
K t/c:	-200	to	1250°C	or	-328	to	2282°F
T t/c:	-200	to	350°C	or	-328	to	662°F
N t/c:	0	to	1250°C	or	32	to	2282°F
S t/c:	0	to	1450°C	or	32	to	2642°F
E t/c:	-200	to	799°C	or	-328	to	1470°F
1° RTD (DIN):	-200	to	700°C	or	-328	to	1292°F
0.1° RTD:	-99.9	to	700.0°C	or	-99.9	to	999.9°F

- ¹ Electromechanical relays are warranted for 100,000 closures only. Solid-state switching devices are recommended for applications requiring fast cycle times or extended service life.
- ² To effect IP65 (NEMA 4X) rating requires a minimum mounting panel thickness of 1.5mm (0.06 inch) and a surface finish not rougher than 0.000812 mm (0.000032 in.).
- ³ When using this output to drive a solenoid, MDR or electromechanical relay (contactor), protect output with a Quencharc®. Order code number 0804-0147-0000. Refer to owner's manual for wiring information. Quencharc® is a registered trademark of ITW Paktron.

Declaration of Conformity

Series 935



WATLOW Winona, Inc.
1241 Bundy Boulevard
Winona, Minnesota 55987 USA

Declares that the following product:

	English
Designation:	Series 935
Model Numbers:	935(A or B) – 1C(C, D or K)(0 or 1) – (Any four letters or numbers)
Classification:	Temperature control, Installation Category II, Pollution degree II
Rated Voltage:	100 to 240 V~ (ac) or 24 to 28 V ≈ (ac or dc)
Rated Frequency:	50 or 60 Hz
Rated Power Consumption:	6 VA maximum

Meets the essential requirements of the following European Union Directives by using the relevant standards show below to indicate compliance.

89/336/EEC Electromagnetic Compatibility Directive

EN 61326:1997 With A1:1998 – Electrical equipment for measurement, control and laboratory use – EMC requirements (Industrial Immunity, Class A Emissions).

EN 61000-4-2:1996 With A1, 1998 – Electrostatic Discharge Immunity
EN 61000-4-3:1997 – Radiated Field Immunity
EN 61000-4-4:1995 – Electrical Fast-Transient / Burst Immunity
EN 61000-4-5:1995 With A1, 1996 – Surge Immunity
EN 61000-4-6:1996 – Conducted Immunity
EN 61000-4-11:1994 Voltage Dips, Short Interruptions and Voltage Variations Immunity
EN 61000-3-2:1995 With A1-3:1999 – Harmonic Current Emissions
EN 61000-3-3:1995 With A1:1998 – Voltage Fluctuations and Flicker

73/23/EEC Low-Voltage Directive

EN 61010-1:1993 With A1:1995 Safety Requirements of electrical equipment for measurement, control and laboratory use. Part 1: General requirements

déclare que le produit suivant :

	Français
Désignation :	Série 935
Numéros de modèle :	935(A ou B) – 1C(C, D ou K)(0 ou 1) – (N'importe quelle combinaison de quatre lettres ou chiffres)
Classification :	Régulation de température, Catégorie d'installation II, Degré de pollution II
Tension nominale :	100 à 240 V~ (c.a.) ou 24 à 28 V ≈ (c.a. ou c.c.)
Fréquence nominale :	50 ou 60 Hz
Consommation d'alimentation nominale:	6 VA maximum

Répond aux normes essentielles des directives suivantes de l'Union européenne en utilisant les standards normalisés ci-dessous qui expliquent les normes auxquelles répondre :

Directive 89/336/CEE sur la compatibilité électromagnétique

EN 61326:1997 avec A1 :1998 – Matériel électrique destiné à l'étalonnage, au contrôle et à l'utilisation en laboratoire – Exigences CEM (Immunité industrielle, Émissions de catégorie A).

EN 61000-4-2:1996 Avec A1, 1998 – Immunité aux décharges électrostatiques
EN 61000-4-3:1997 – Immunité aux champs de radiation
EN 61000-4-4:1995 – Immunité contre les surtensions électriques rapides/ Rafale
EN 61000-4-5:1995 avec A1, 1996 – Immunité contre les surtensions
EN 61000-4-6:1996 – Immunité conduite
EN 61000-4-11:1994 Immunité contre les écarts de tension, interruptions courtes et variations de tension
EN 61000-3-2:1995 avec A1-3 :1999 – Émissions de courant harmoniques
EN 61000-3-3:1995 avec A1 :1998 – Fluctuations et vacillements de tension

Directive 73/23/CEE sur les basses tensions

EN 61010-1:1993 avec A1 :1995 Normes de sécurité du matériel électrique pour la mesure, le contrôle et l'utilisation en laboratoire. 1ère partie : Conditions générales

Erklärt, dass das folgende Produkt:

	Deutsch
Bezeichnung:	Serie 935
Modell-Nummern:	935(A oder B) – 1C(C, D oder K)(0 oder 1) – (Beliebige vier Ziffern oder Buchstaben)
Klassifikation:	Temperaturregler, Installationskategorie II, Verschmutzungsgrad II
Nennspannung:	100 bis 240 V~ (ac) oder 24 bis 28 V ≈ (AC oder DC)
Nennfrequenz:	50/60 Hz.
Nennstromverbrauch:	6 VA max.

Erfüllt die wichtigsten Normen der folgenden Anweisung(en) der Europäischen Union unter Verwendung des wichtigsten Abschnitts bzw. der wichtigsten Abschnitte die unten zur Befolgung aufgezeigt werden.

89/336/EEC Elektromagnetische Kompatibilitätsrichtlinie

EN 61326:1997 mit A1:1998 – Elektrisches Gerät für Messung, Kontrolle und Laborgebrauch – EMV-Anforderungen (Störfestigkeit Industriebereich, Klasse A Emissionen)

EN 61000-4-2:1996 mit A1, 1998 – Störfestigkeit gegen elektronische Entladung
EN 61000-4-3:1997 – Störfestigkeit gegen Strahlungsfelder
EN 61000-4-4:1995 – Störfestigkeit gegen schnelle Stöße/Burst
EN 61000-4-5:1995 mit A1, 1996 – Störfestigkeit gegen Überspannung
EN 61000-4-6:1996 – Geleitete Störfestigkeit
EN 61000-4-11:1994 Störfestigkeit gegen Spannungsabfall, kurze Unterbrechungen und Spannungsschwankungen
EN 61000-3-2:1995 mit A1-3:1999 – Harmonische Stromemissionen
EN 61000-3-3:1995 mit A1:1998 – Spannungsfuktationen und Flimmern

73/23/EEC Niederspannungsrichtlinie

EN 61010-1:1993 mit A1:1995 Sicherheitsanforderungen für elektrische Geräte für Messungen, Kontrolle und Laborgebrauch. Teil 1: Allgemeine Anforderungen

Declara que el producto siguiente:

	Español
Designación:	Serie 935
Números de modelo:	935(A o B) – 1C(C, D o K)(0 o 1) – (Cualesquiera cuatro letras o números)
Clasificación:	Control de temperatura, Categoría de instalación II, Grado de contaminación II
Voltaje nominal	100 a 240 V~ (CA) o 24 a 28 V ≈ (CA o CD)
Frecuencia nominal:	50 o 60 Hz
Consumo de energía nominal:	6 VA máximo

Cumple con los requisitos esenciales de las siguientes Directrices de la Unión Europea mediante el uso de las normas aplicables que se muestran a continuación para indicar su conformidad.

89/336/EEC Directriz de compatibilidad electromagnética

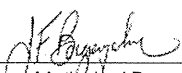
EN 61326:1997 CON A1:1998.– Equipo eléctrico para medición, control y uso en laboratorio – Requisitos EMC (Inmunidad industrial, Emisiones Clase A).

EN 61000-4-2:1996 con A1, 1988 – Inmunidad a descarga electrostática
EN 61000-4-3:1997 – Inmunidad a campo radiado
EN 61000-4-4:1995 – Inmunidad a incremento repentino/rápidas fluctuaciones eléctricas transitorias
EN 61000-4-5:1995 con A1, 1996 – Inmunidad a picos de voltaje o corriente
EN 61000-4-6:1996 – Inmunidad por conducción
EN 61000-4-11:1994 Inmunidad a caídas de voltaje, variaciones y pequeñas interrupciones de voltaje
EN 61000-3-2:1995 con A1-3:1999 – Emisiones de corriente armónica
EN 61000-3-3:1995 con A1:1998 – Fluctuaciones de voltaje y centelleo.

73/23/EEC Directriz de bajo voltaje

EN 61010-1:1993 con A1:1995 Requisitos de seguridad de equipo eléctrico para medición, control y uso en laboratorio. Parte 1: Requisitos generales

<u>Jim Boigenzahn</u>	<u>Winona, Minnesota, USA</u>
Name of Authorized Representative	Place of Issue
<u>General Manager</u>	<u>August, 2001</u>
Title of Authorized Representative	Date of Issue


Signature of Authorized Representative



935A Software Map

Prompt	Range	Default	Hidden if *	Your Settings
SP Primary Set Point	rL rH Select a value, adjustable between Input Type Range Low and Input Type Range High.	75°F or 23°C	Appears always	
Aut Auto-tune	no YES Choose YES to Auto-tune the 935A.	no	TAG = A	
ALD Alarm Low	RHL Select a value, adjustable between Range Low and Alarm High.	Type J Range Low	TAG = 0 ; or if DET1 and DET2 ≠ ALPT	
RHI Alarm High	rLO Select a value, adjustable between Alarm Low and Range High.	Type J Range High	TAG = 0 ; or if DET1 and DET2 ≠ ALPT	
ETTC Countdown Timer	0000 Select a countdown time value, adjustable between 00:00 and 99:59 hrs:mins or min:sec.	0	TAG = 0 ; or if DET2 ≠ ETPT or ETTS	
IDLE Idle Set Point Type	ETRC rL rH Choose an idle Set Point. Trac is an Idle Set Point equal to the Primary Set Point; or select a value between Input Type Range Low and Input Type Range High.	ETRC	TAG = 0 ; or if DET2 ≠ ETPT or ETTS	

*NOTE:
All prompts, except and , are hidden if = .

Prompt	Range	Default	Hidden if *	Your Settings
L-r Local/Remote Set Point	L r Choose Local or Remote Set Point.	L	ERR = 0 ; or if DE1 ≠ rSP	
Pid PID Menu	no YES Choose YES to move to the PID Menu.	no	ERR = P	
CONF Configuration Menu	no YES Choose YES to move to the Configuration Menu.	no	The front panel is locked out.	
Pb h Proportional Band Heat	0 999 0 555 0.0 999.0 0.0 555.0 Select a value in whole degrees (0°F to 999°F or 0°C to 555°C) or in tenths of degrees (0.0°F to 999.0°F or 0.0°C to 555.0°C).	25°F or 17°C	ERR = P ; or if DE1 and/or DE2 ≠ HERE	
hYSh Hysteresis Heat	1 999 1 555 0.1 999.0 0.1 555.0 Select a value in whole degrees (1°F to 999°F or 1°C to 555°C) or in tenths of degrees (0.1°F to 999.0°F or 0.1°C to 555.0°C).	3°F or 2°C	ERR = P ; or if Pb h ≠ 0	

Prompt	Range	Default	Hidden if *	Your Settings
CL h Cycle Time Heat	0.1 60.0 5.0 60.0 Select a value between 0.1 and 60.0 seconds (Solid-State Relay or Switched DC) or 5.0 and 60.0 seconds (Electromechanical Relay).	1.0 second	LAG = P or if Pb h = 0	
db Dead Band	0 999 0 555 0.0 999.0 0.0 555.0 Select a value in whole degrees (0°F to 999°F or 0°C to 555°C) or in tenths of degrees (0.0°F to 999.0°F or 0.0°C to 555.0°C).	0°F or 0°C	LAG = P or if DE1 = cool and DE2 ≠ heat or if DE1 = heat and DE2 ≠ cool	
Pb c Proportional Band Cool	0 999 0 555 0.0 999.0 0.0 555.0 Select a value in whole degrees (0°F to 999°F or 0°C to 555°C) or in tenths of degrees (0.0°F to 999.0°F or 0.0°C to 555.0°C).	25°F or 17°C	LAG = P or if DE1 ≠ cool and/or DE2 ≠ cool	
hyst c Hysteresis Cool	1 999 1 555 0.1 999.0 0.1 555.0 Select a value in whole degrees (1°F to 999°F or 1°C to 555°C) or in tenths of degrees (0.1°F to 999.0°F or 0.1°C to 555.0°C).	3°F or 2°C	LAG = P or if Pb c ≠ 0	

Prompt	Range	Default	Hidden if *	Your Settings
CT c Cycle Time Cool	0.1 60.0 5.0 60.0 Select a value between 0.1 and 60.0 seconds (Solid-State Relay or Switched DC) or 5.0 and 60.0 seconds (Electromechanical Relay).	5.0 seconds	LAG = P ; or if Pb c = 0 or if Pb c is hidden	
IL Integral Function	0.0 99.99 Select a value, adjustable between 0.0 and 99.99 minutes/repeat.	5.00 minutes/repeat	LAG = P ; or if Pb h = 0; or if Pb h is hidden; and if Pb c = 0; or if Pb c is hidden	
dE Derivative Function	0.00 9.99 Select a value, adjustable between 0.00 and 9.99 minutes.	0 minutes	LAG = P ; or if Pb h = 0; or if Pb h is hidden; and if Pb c = 0; or if Pb c is hidden	
LRL Calibration Offset	-999 9999 -99.9 999.9 Select a value, adjustable between -999° and 9999°F or C or -99.9° and 999.9°F or C to eliminate a difference between the displayed temperature and the actual temperature.	0°F or 0°C	LAG = P	

Prompt	Range	Default	Hidden if *	Your Settings
In Input Type	J J t/c H K t/c E T t/c N N t/c E E t/c S S t/c rtd 1.0°RTD rtd 0.1°RTD	J	LR9 = C	
C_F Celsius/Fahrenheit	°F °C Choose to indicate temperature in °Fahrenheit or °Celsius.	F	LR9 = C	
rL Range Low	In rh Select a value between Input Type Range Low and Input Range High.	Type J range low value	LR9 = C	
rh Range High	rL In Select a value between Input Type Range High and Input Range Low.	Type J range high value	LR9 = C	
DE1 Output 1 Function	HEAT COOL ALP1 rSP FPL none Choose Heat, Cool, Alarm, Remote Set Point, Front Panel Lock or No output action.	heat	LR9 = C	

Prompt	Range	Default	Hidden if *	Your Settings
0E2 Output 2 Function	HEAT COOL ALP7 EHP7 EP75 none Choose Heat, Cool, Alarm, Timer (Hrs:Min), Timer (Min:Sec) or No output action.	none	EA9 = C	
dISP Display Default	Ac ACSP ACEI EIRc EISP Choose the primary (last 2 characters) and secondary (first 2 characters) Default displays. Press SE to toggle to the secondary display for 15 seconds.	Ac	EA9 = C	
ALLEY Alarm Type	Prnc Prno dEnc dEno Choose an alarm type: Process normally closed, Process normally open, Deviation normally closed or Deviation normally open.	Prnc	EA9 = C ; or if 0E1 and/or 0E2 ≠ ALP7	
RhYS Alarm Hysteresis	1 999 1 555 0.1 999.0 0.1 555.0 Select a value in whole degrees (1°F to 999°F or 1°C to 555°C) or in tenths of degrees (0.1°F to 999.0°F or 0.1°C to 555.0°C).	3°F or 2°C	EA9 = C ; or if 0E1 and/or 0E2 ≠ ALP7	

Prompt	Range	Default	Hidden if *	Your Settings
LAL Alarm Latch	no YES Choose YES for a Latching Alarm.	no	LAG = C ; or if DE1 and/or DE2 ≠ ALPN	
SIL Alarm Silencing	no YES Choose YES for a Silenced Alarm on start-up or silencing during operation.	no	LAG = C ; or if DE1 and/or DE2 ≠ ALPN	
FAIL Input Failure Mode	bPLS -100 100 Choose Bumpless Transfer or Percent Power.	Bumpless	LAG = C ; or if DE1 and DE2 ≠ HEAT or COOL	
EPN Timer Output Function	dLoN dLoF SOON SOOF Choose Delay ON, Delay OFF, Signal ON, or Signal OFF.	Delay OFF	LAG = C ; or if DE2 ≠ EPN or EPFS	
SETE Start Timer Function	IPNd rdY rdYA PLJR Choose Immediate, Ready Band, Ready Band Acknowledge, or Power.	Immediate	LAG = C ; or if DE2 ≠ EPN or EPFS	
rdY Timer Ready Band	0 999 0 555 0.0 999.0 0.0 555.0 If SETE = rdYA or rdY , then select a value in whole degrees (0°F to 999°F or 0°C to 555°C) or in tenths of degrees (0.0°F to 999.0°F or 0.0°C to 555.0°C).	0°F or 0°C	LAG = C ; or if DE2 ≠ EPN or EPFS	

Prompt	Range	Default	Hidden if *	Your Settings
SE Signal Time	1 99 9 If ETPT = 59on or 59oF , then select a value between 00:01 and 99:59 min:sec.	00:01	ETAG = C ; or if ETPT ≠ 59on or 59oF	
SLOC Set Point Lockout	no YES Choose YES to Lock the Primary Set Point.	no	ETAG = C	
ETAG Lockout Tag	PCOR COA PCO CO PCA CA PC C POA OA PO O PA A P Choose the menus/functions that will not be displayed, and therefore cannot be changed. P = PID Menu C = Configuration Menu (except tag) O = Operations Menu (except CONF) A = Auto-tune	P	Always appears	

About Watlow Winona

Watlow Winona is a U.S. division of Watlow Electric Manufacturing Company, St. Louis, Missouri, a manufacturer of industrial electric heating products since 1922. Watlow products include electric heaters, sensors, controllers and switching devices. The Winona operation has been designing solid-state electronic control devices since 1962, and has earned the reputation as an excellent supplier to original equipment manufacturers. These OEMs and end users depend upon Watlow Winona to provide compatibly engineered controls that they can incorporate into their products with confidence. Watlow Winona resides in a 100,000-square-foot marketing, engineering and manufacturing facility in Winona, Minnesota.

Warranty

The Watlow Series 935 is warranted to be free of defects in material and workmanship for 36 months after delivery to the first purchaser for use, providing that the units have not been misapplied. Since Watlow has no control over their use, and sometimes misuse, we cannot guarantee against failure. Watlow's obligations hereunder, at Watlow's option, are limited to replacement, repair or refund of purchase price, and parts which upon examination prove to be defective within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse, or abuse.

Returns

- Call or fax your distributor or the nearest Watlow sales office for best information about returns. (See outside back cover.)
- To return directly to Watlow Winona in the U.S., first call or fax Customer Service for a Return Material Authorization (RMA) number (telephone: +1 (507) 454-5300; fax: +1 (507) 452-4507).
- Put the RMA number on the shipping label, along with on a written description of the problem.
- A restocking charge of 20% of the net price is charged for all standard units returned to stock.

How to Reach Us



Quality and Mission Statement:

Watlow Winona will be the world's best supplier of superior measurement and control products, services, and systems, by exceeding the expectations of our customers, shareholders, and employees.

Your Authorized Watlow Distributor:

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Fax: +886 (7) 288-5568